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GJPO/MRAP-5

Monticello Remedial Action Project

Statement of Work
1991 Millsite Characterization Study

March 1991

Work performed under DOE Contract No. DE-AC07-86ID12584 for the **U.S. Department of Energy**
Grand Junction Projects Office

Geotech, Inc.

STATEMENT OF WORK

MONTICELLO REMEDIAL ACTION PROJECT
1991 MILLSITE CHARACTERIZATION STUDY

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STATEMENT OF WORK

1.0 INTRODUCTION

This project is a characterization study for the Monticello millsite including the BLM compound and an area west to Highway 191. The successful subcontractor will submit a work plan, Health and Safety plan, QA/QC plan including procedures, transportation plan, and sampling plan. Once the documents have been approved by Geotech, the subcontractor will implement all plans and ultimately prepare draft and final reports documenting the investigation.

The project is being directed by Chem-Nuclear Geotech, Inc. (herein known as Geotech), a Contractor to the United States Department of Energy (DOE). This work is being done as part of the DOE's implementation of the Surplus Facilities Management Program (SFMP).

The Monticello Remedial Action Project (MRAP) is currently administered by the Grand Junction Project Office (GJPO) of the DOE. The major environmental regulations governing the cleanup of the millsite and the design of an adjacent repository are the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), including amendments to these acts. The millsite is listed on the National Priority List in accordance with CERCLA/SARA. All references herein to CERCLA include the SARA amendments and UMTRCA as the primary ARAR. In accordance with CERCLA, the signed Record of Decision stipulates that contaminated materials from the millsite will be moved approximately one mile south and disposed of in a permanent repository. This statement of work supports that objective.

1.1 General Background Information

The uranium mill at Monticello Utah was one of the earliest to operate on the Colorado Plateau and was at the forefront of developments on uranium milling technology throughout its period of operation. The Monticello Mill was one of the first mills in the United States to utilize the acid leach resin-in-pulp process and was the first to use the carbonate leach resin-in-pulp process. Mill operations at Monticello were also a focal point of early environmental concerns. The Mill was closed in 1960. The Monticello Remedial Action Project was established to restore the government owned millsite to safe levels of radioactivity and to dispose of and contain the tailings from the milling process in an environmentally safe manner.

In Summer 1961, the Atomic Energy Commission began to regrade, stabilize, and vegetate the piles. This work was initiated on the East Pile because, being the largest pile, it presented the greatest potential for wind erosion and migration of tailings off site. At the onset, a small pond still existed in the lowest part of the East Pile and it was drained to the extent possible. Slimes retained considerable moisture, even in "dry" parts of the pile, and many areas would not support heavy equipment. To overcome this obstacle, tailings sand was hauled from the other three piles and spread over the surface. These tailings mixed with the fluid slimes to provide a stable surface over which cover material could be spread. The depth of sand fill reached as much as 6 feet in places but averaged 3 or 4 feet. After the grading was completed, 8 to 12 inches of fill dirt and rock, excavated nearby, were spread over the tops and sides of the piles. Topsoil was added to the tops of the piles, fertilized, and seeded with a variety of native grasses (U.S. Atomic Energy Commission, 1963).

The mill facilities were dismantled concurrently. Equipment was sold to private firms, and unsold scrap material was buried or burned. Trenches were excavated near the Carbonate Pile and scrap was buried under several feet of tailings. These tailings were covered with rock and soil and seeded in the same way as the piles (Paas, 1966). Slabs and foundations in the mill area were broken and buried in trenches adjacent the individual foundation. The area was then graded and seeded.

1.1.1 Location

The project site consists of the 78 acre Monticello Millsite and adjacent government owned property. This adjacent property is commonly referred to as the BLM compound and BLM property. The project site is located along Montezuma Creek, one-quarter mile south of the City of Monticello, Utah, in the north-central portion of San Juan County, Utah. It lies directly east of U.S. Highway 191. The millsite property lies in Section 36, Township 33 South, Range 23 East, and in Section 31, Township 33 South, Range 24 East (Salt Lake Meridian). Refer to Figures 1 and 2.

1.1.2 Access

Access to the project site is via good all-weather roads. Each individual drill site should be accessible with truck mounted equipment. Access routes will be established on site as drilling operations occur. Uncontaminated and contaminated boundaries have been established and routes into each area will be designated during the operations. See attached health and safety plan for pre-entry requirements. Routes into the contaminated area will require frisking stations and decontamination sites for all equipment and personnel entering and leaving the area.

1.1.3 Subsurface Conditions

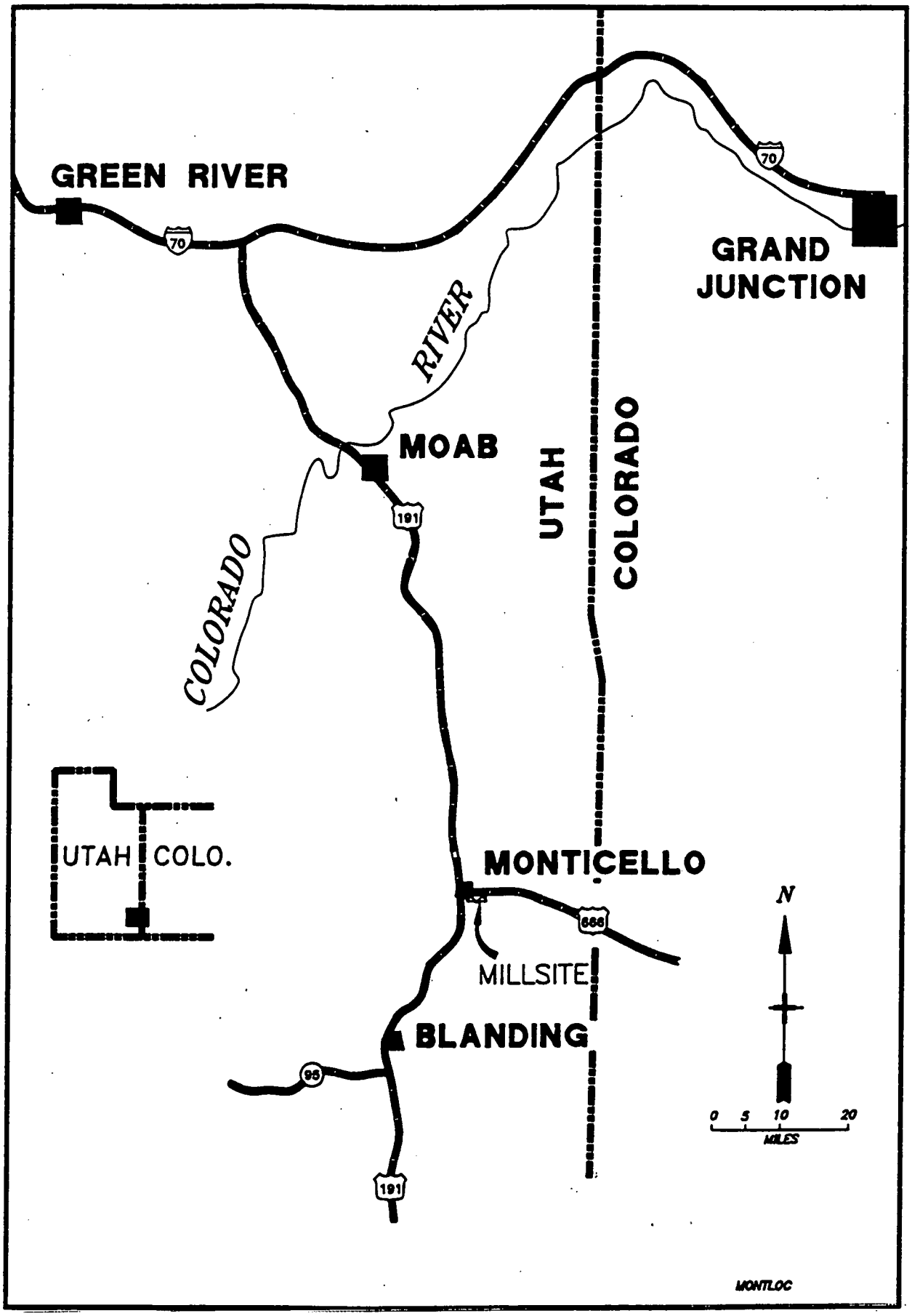
The majority of drilling will occur in uranium mill tailings. The generalized stratigraphy encountered during previous drilling at the site consists of an assemblage of alluvial sands and gravels, as well as uranium mill tailings that overlie bedrock units of the Mancos Shale, Dakota Sandstone, and Burro Canyon Formation. Appendix A contains a geologic description of the units, as well as local geologic maps and cross sections.

The Subcontractor should be aware that actual conditions encountered during the drilling on this project may vary significantly from the mentioned conditions and should not rely solely on these assumptions to base costs on. Excerpts from a previous geotechnical and radiologic investigation are included as Appendix G.

Geotech will attempt to locate underground utilities or hazards in the area. The Subcontractor shall verify buried utilities or hazards. Geotech will supply the successful bidder with maps showing the known utility locations. The Subcontractor shall exercise extreme care to avoid underground utilities.

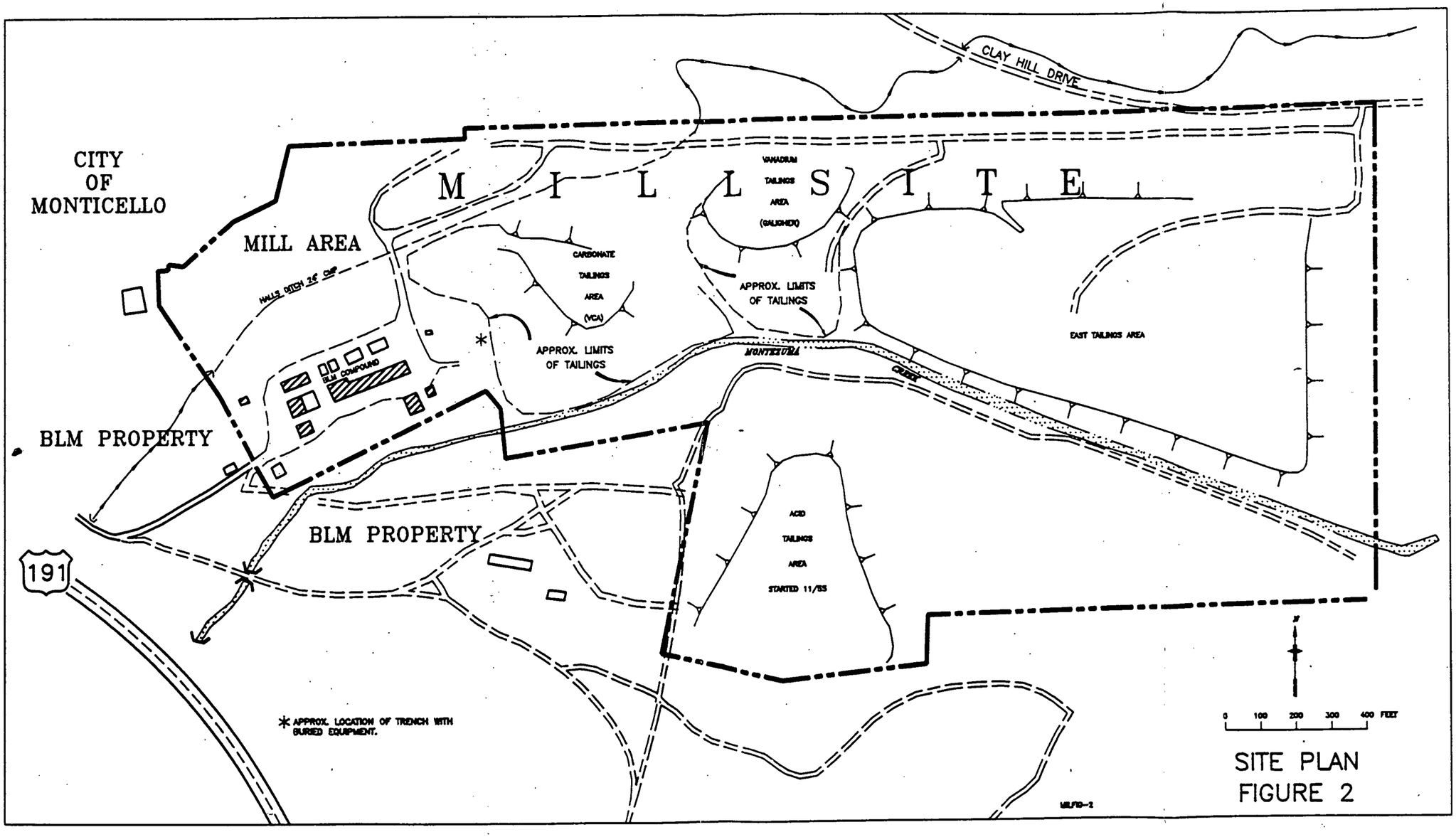
1.1.4 Site Hazards

The millsite has been previously characterized as containing many radiological and chemical hazards. The attached health and safety plan, Appendix D, contains the results of a hazardous substance investigation previously conducted at the millsite. The successful Subcontractor will be required to submit, for Geotech approval, a plan to deal with the hazards as part of the work plan. This will include items such as contamination control, waste disposal, care of samples, decontamination, and personnel health and safety issues.



LOCATION MAP

FIGURE 1



SITE PLAN
FIGURE 2

1.2 Previous Site Investigations

Several limited site investigations have been performed. The successful bidder can review these materials upon request.

2.0 GENERAL SCOPE

This project consists of two main investigation techniques, drilling and test pits. Drilling will primarily consist of hollow stem auger techniques. Utilization of a backhoe is anticipated to excavate test pits. Refer to sections 8.0 and 9.0 for details.

Investigations will consist of downhole gamma radiation and moisture logging; sampling and testing for metals, organics compounds, and radon properties; geotechnical laboratory testing; construction and materials testing; and installing observation wells and piezometers. Geotech will be responsible for several of these tasks. Refer to sections 8.0, 9.0, and 11.0 for details.

3.0 PURPOSE

The purpose of this project is to better define extent and types of contaminants, identify geotechnical and radiological properties of contaminated materials, and identify constructibility concerns. Areas under investigation include the east tailings pile, the carbonate tailings pile, the vanadium tailings pile, the acid tailings pile, the mill area, the BLM areas, and areas used for ore storage. Listed below are specific goals and objectives to be attained by this investigation and described in the final report.

- Determine the depth of radiologic contamination. Measurements of gamma radiation and total radioactivity are the indicators of radiologic contamination.
- Establish the total metals and nitrate concentrations in the tailings piles.
- Investigate for presence of organic compounds using field screening techniques.
- Quantify the concentrations of Radium-226 in distinct tailings units, (individual piles and materials, such as slimes, sands, etc.)
- Ascertain if thorium-230, uranium, arsenic, selenium, vanadium, molybdenum, or other heavy metals have migrated farther than Ra-226 and if so, to estimate the extent of that migration.
- Install observation wells to facilitate future ground water sampling for metals and organic compounds and to determine ground water levels. These data will be utilized for construction purposes.
- Prepare lithologic logs of borings.
- Provide information to help Geotech estimate the volumes and layering of different materials, i.e. tailings sands, slimes, and other contaminated materials.
- Ascertain the geotechnical properties of the contaminated materials.
- Observe and document subsurface conditions and soil classification on the site.

- Assess materials handling and recompaction issues during construction. Also, evaluate how in situ moisture content relates to the desired moisture content.
- Determine soil hydraulic properties of tailings materials.
- Quantify radon emanation and radon diffusion characteristics from the contaminated materials.
- Collect soil samples from test pits to facilitate radon and geotechnical testing.
- Develop a pH profile of the tailings.
- Develop information to help Geotech analyze placement of contaminated materials in the repository.
- Help identify anticipated construction problems.
- Specifically indicate vertical limits of radiologic, metals, and nitrate contamination in the tailings piles. Also, assess the nature of metals and organic compound contamination outside the tailings piles using screening techniques.

An interpretive report will be developed to document the investigation program and to aid Geotech in design and construction. The report will be used as guidance with issues such as ground water levels, soil mechanics, soil-water balance parameters, radon flux parameters, repository cover design, construction techniques, limits of cleanup, and solute transport modeling. Note that these design and construction aspects are not part of this statement of work.

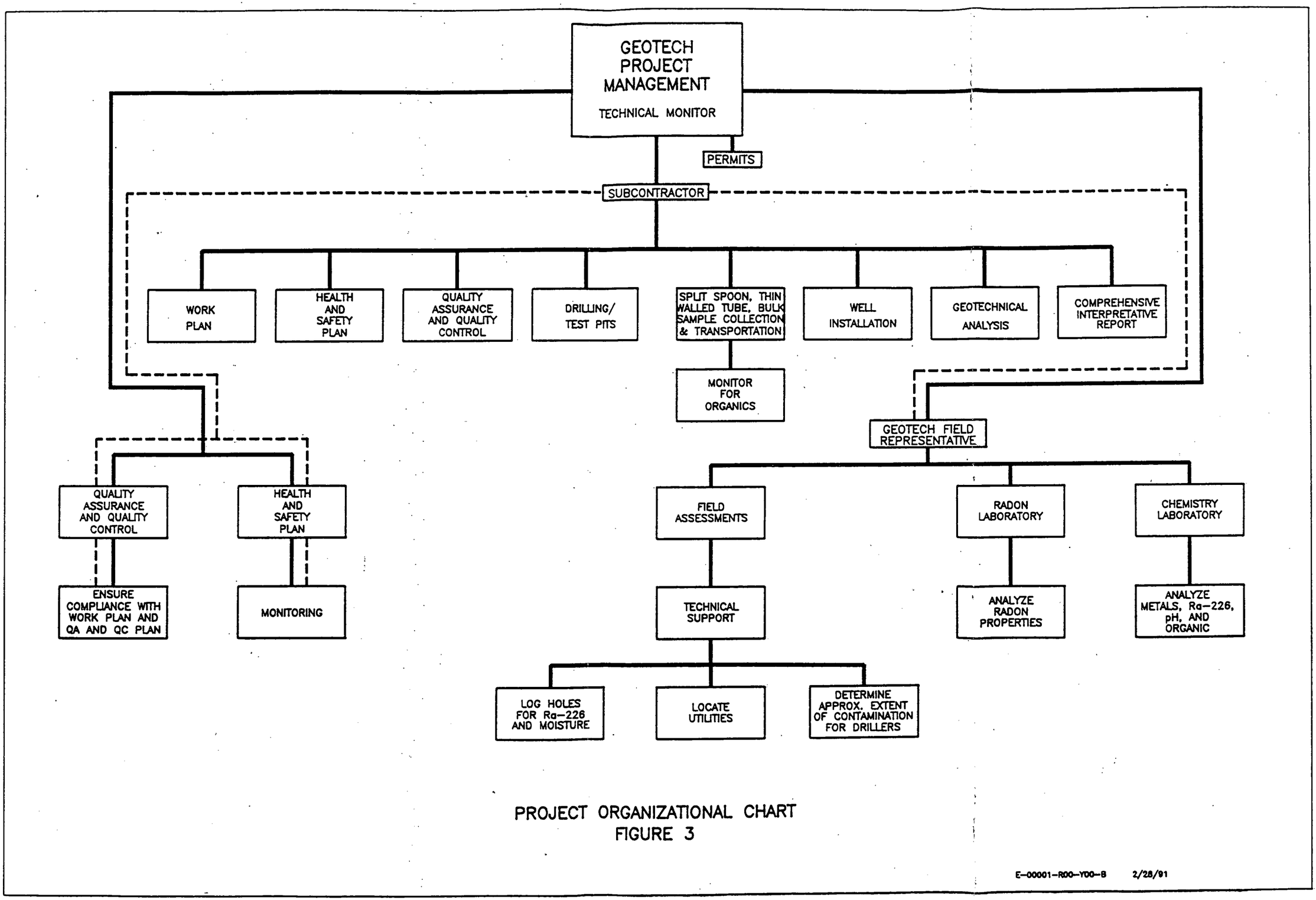
See Section 13.0 for specific requirements of the report, Section 20.0 for the submittal schedule, and Section 21.0 for period of performance.

4.0 PROJECT ORGANIZATION AND COMMUNICATION

This investigation is intended to be comprehensive in nature. As such, it requires cooperative interaction between the Subcontractor and Geotech. The Subcontractor will assume lead responsibility for the project while Geotech retains active project oversight. Several integral specialized tasks of this project will be performed by Geotech at the Subcontractor's direction. Tasks identified in this statement of work provide specific guidance on sample frequencies and collection and general guidance in other areas. The Subcontractor, through development of the work plan, shall establish details necessary to perform the identified tasks.

Specific responsibilities of the Subcontractor include development of a work plan, health and safety plan, QA/QC procedures, transportation plan, sampling plan, and implementation of the statement of work. The statement of work includes drilling/test pits; split spoon, thin-walled tube, and bulk sample collection and labeling; sample transportation to Geotech's and the subcontractor's laboratories; sampling design; well completion; geotechnical analysis; and preparation of a comprehensive report.

Responsibilities of Geotech include the following: survey drill hole and test pit locations, log holes for radiologic contamination and moisture, monitor QA/QC procedures, laboratory analysis of soil samples, monitor some aspects of health and safety issues, and provide the Subcontractor with results of work performed by Geotech.



PROJECT ORGANIZATIONAL CHART
FIGURE 3

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Geotech project management will consist of a Technical Monitor and a Field Representative. A procurement agent is assigned to coordinate the contract. Communication for daily activities shall be with the Field Representative and the Technical Monitor as necessary. Exclusive of change orders, communication concerning cost within the contract limits will be directed to the Technical Monitor. If the dollar amount exceeds the contract amount, contract schedule, a change order is necessary, or the scope of work changes, the Technical Monitor and the Procurement Agent must be immediately notified. Geotech's Field Representative will be present on site whenever investigational activities occur.

See Figure 3 for the project organizational chart.

Refer to specific sections for more detailed information of responsibility.

5.0 PERMITS AND LICENSES

Geotech will obtain "valid authorization" as required by section 2.23 of Appendix C to construct the observation wells. The Subcontractor will acquire and pay for any required drilling and/or Subcontractor licenses. The Subcontractor must possess a State of Utah Water Well Drillers License. Proof of license shall be submitted to Geotech prior to start of work. This is not a reimbursable expense.

6.0 EXPLORATION LOCATIONS

Borehole locations will be located and surveyed by Geotech personnel prior to drilling. No borehole location may be moved or changed unless approved by the Geotech Technical Monitor. Test pits will be located based on Borehole Logs and will also be sited and surveyed by Geotech personnel.

7.0 WORK PLAN

The Subcontractor shall prepare and submit to Geotech within 14 days of Notice of Award a detailed work plan that addresses health and safety (including emergency provisions), the Statement of Work, procedures to be utilized, quality assurance, cost and schedule control mechanisms, detailed cost break down, and mechanisms to develop data continuity with the outline in Appendix F. The work plan shall show interaction with Geotech laboratory and logging functions as (1) output from Subcontractor to Geotech and (2) as input from Geotech to Subcontractor. Submit the work plan to Geotech for review within 14 days from notice of award. See Appendix E for other work plan content.

8.0 DRILLING AND SAMPLING TASKS

8.1 Drilling

The investigation will consist of drilling approximately 82 boreholes an average of 23 feet deep (ranging in depth from 10' to 55') for a total of approximately 1,900 feet. Sixteen test pits will be excavated and backfilled (refer to Plate 1). They may be as deep as 30 feet but are anticipated to average 15 feet deep. The boreholes in the tailings piles will be drilled approximately 5 feet into the first formational bedrock contact, either Mancos Shale or Dakota Sandstone. These boreholes will be completed as observation wells, see section 8.1.4.

The purpose of the boreholes outside the tailings piles is to investigate depths of shallow radiologic contamination, ground water levels, and identify hazardous wastes. Several of these boreholes will be completed as piezometers or simply backfilled if dry. A few of these boreholes will be drilled to water, in which case an observation well will be installed. The identity of these holes will be determined in the field.

The estimated depth of each borehole is indicated on Plate 1. Geotech will determine the final depth of each borehole by approximating the extent of radiologic contamination. Boreholes will be drilled and sampled using hollow-stem auger methods and procedures.

The primary method of drilling and sampling will be with hollow stem augers, and with drive and thin walled tube sampling devices. Unfavorable subsurface conditions may be encountered, and several different drilling techniques may be needed to aid the auger drilling effort. These supplemental techniques may include but are not limited to maintaining maximum hydrostatic head within the hollow stem augers to minimize borehole wall collapse, using retrievable flush-joint casing through unstable zones, and other such methods. Subcontractor shall be prepared to rotary drill or core through the stem of the auger. Any deviation(s) from standard hollow stem auger practices will be coordinated with and approved by Geotech's field representative prior to implementation to ensure that project objectives will not be jeopardized.

Subsurface soil sampling shall occur at a minimum frequency of 1 sample every 5' auger flight and at each lithologic change. The nature of the materials (tailings, sands, and slimes) may require significant finesse to ensure retainage of sample in sampling device. In addition, special sampling techniques may be required in the alluvial gravels under the tailings piles. It is anticipated that about 30 per cent of sampling will utilize a standard 3-inch nominal thin walled tube for undisturbed soil samples. The remaining 70 percent of the sampling will utilize a stainless steel 3-inch OD x 24 inch long split barrel sampler. Auger cuttings may be collected as directed by the drilling supervisor. All drilling, sampling, and lithologic soil descriptions shall follow the appropriate ASTM Standards as listed in Section 21.0. Actual sample locations are subject to modification. See section 11.3.2 for required soils testing.

The Subcontractor shall use precaution when drilling to prevent unnecessary downhole contamination from upper zones in each borehole. Address these precautions in the work plan.

All drilling fluids and/or wastes shall be contained at each drillsite and disposed of on site as directed by Geotech.

8.1.1 Drilling Fluids and Additives

The objectives of this project restrict the use of fluids or additives during the drilling process. Any fluids used on this project must be approved by Geotech prior to use. All lubricants must be approved by Geotech prior to use. Avoid the use of drilling fluids and pipe or auger lubricants that contain or are contaminated with lead, molybdenum, lithium, or other additives that might adversely affect chemical analyses of water samples. All excess lubricants shall be removed from downhole tools prior to their use. All discharged drilling fluids other than water, as well as other drilling wastes, shall be contained at each drill site and disposed of as directed by Geotech.

Water for drilling has, in the past, been available by purchase from the public water supply system in the City of Monticello and is the responsibility of the Subcontractor. If water is no longer available from the City, due to drought conditions, a private source must be obtained. This source must be tested, and must be approved by Geotech prior to use. Water must meet the State of Utah drinking water standards. The Subcontractor is responsible for this testing.

8.1.2 Borehole and Driller's Logs

The Subcontractor shall furnish Geotech typed and drafted boring logs in the final report detailing sample intervals, stratigraphy, moisture content profile, types of laboratory testing performed for each sample, readings from OVA/HNU meter, and well completion details. In addition to standard reported data as outlined in ASTM Drilling Methods, a separate copy of the actual field borehole logs shall be provided at the completion of each borehole and observation well and shall be forwarded to Geotech field representative on a per completion basis and no later than one day following completion. A daily drillers log detailing all rig functions, footages, cores, sample intervals and location, bit records, pipe and materials tallies, and other pertinent drilling data shall be available, for Geotech review, at the end of each shift or start of the following shift. Submit driller's logs to Geotech weekly. Geotech will furnish the borehole log form to be used or the Subcontractor's standard form may be used upon prior approval by Geotech.

8.1.3 Integration with Geotech Field Assessment/Downhole Logging

Throughout the program, the Subcontractor will integrate with Geotech Field Assessment personnel in determining the extent of radiologic contamination and logging boreholes. Preliminary extent of radiologic contamination will be determined by Geotech personnel. This procedure will consist of using a RASCAL PRS-1 or equivalent total count downhole probe and will require approximately five minutes per occasion. Its maximum depth is 50 feet. Consequently, after 50' depth judgment will be necessary to determine extent of drilling. The Subcontractor is required to incorporate the data acquired by Geotech into the overall project.

Boreholes will be radiologically logged by Geotech Field Assessment personnel using a truck mounted logging device. Anticipated logging time is approximately 45 minutes for a 20 foot hole up to 90 minutes for a 50 foot hole. To avoid down time for the drill rig, the Subcontractor shall provide enough auger flights to leave the auger in one hole and move on to the next hole while the first hole is being logged. It is recommended that high torque drill rigs be employed. Supply Geotech with two auger flights of size to be used, for instrument calibration, two weeks before work commences.

A hard copy of the data will be provided to the Subcontractor for inclusion in the report.

8.1.4 Drill Hole Completion

Approximately 82 drill holes are anticipated for characterization of the millsite. Plate 1 shows the layout for the proposed drill holes. Completion shall adhere to the State of Utah Administrative Rules for water well drillers, as minimum guidelines for acceptable standards. This addresses monitoring wells (see Appendix C). Subcontractor must possess a water well license for the State of Utah.

Wells will be completed in the alluvial gravel and tailings deposits. The thickness of these deposits is expected to be in the range of 15 to 60 feet. Approximately 5 to 20 feet of machine slotted screen will be used to complete each well. The Subcontractor is responsible for determining completion requirements according to material characteristics of individual drill holes. Design the sand pack and screen size according to procedures outlined in ASTM D5092 dated June 27, 1990. Complete each observation well as specified in Appendix B.

Several shallow dry holes, less than 15 feet deep, will be completed as piezometers or simply backfilled. Completion details including screen length and size as well as the sand pack will be designed by the Subcontractor. Refer to ASTM D5092 and Appendix B for details. Coordinate dry hole completion requirements with Geotech's field representative.

Well development water shall be contained in a pit at each well. Backfill the pit after water subsides.

Approach this program incrementally. Materials shall not be purchased in volume greater than those agreed to with Geotech, as the program could be stopped short of the total estimated scope based on actual geotechnical findings and/or funding restrictions.

8.1.5 Drill Hole Abandonment

As a minimum in the event that a drill hole requires abandonment, the State of Utah regulations and directives shall apply. Additional requirements may be imposed by Geotech depending on the specific circumstances surrounding the drill hole. A copy of the State of Utah Administrative Rules for Water Well Drillers is included as Appendix C.

8.1.6 Mandatory Minimum Equipment

The subcontractor shall submit a mandatory minimum equipment list to Geotech for approval with the proposal. This list shall address all equipment required to satisfy the period of performance. After approval, this equipment list will become mandatory for field operations.

8.2 Sampling

The Subcontractor is responsible for collecting and properly labeling all samples. Sampling procedures are outlined in the following subsections. The subcontractor shall prepare a sampling plan addressing all items in this section. Submit this plan for approval by Geotech with the work plan. It shall address procedures for sample collection, containers, sealing, and labeling.

All sampling shall be designed to obtain Data Quality Objective level III data at a minimum. Necessary QA/QC requirements shall be addressed.

Samples shall be transported to Geotech by the subcontractors. Follow all federal, state, and local transportation regulations. Some samples may allow shipment as "limited quantity." However, anticipate shipping some samples in "Type A" packaging. A DOT certified shipper will be required. Proper chain of custody must be initiated and maintained. The subcontractor shall submit a transportation plan to Geotech for approval with the work plan. Transmit manifests and associated shipping and chain of custody documents with samples.

8.2.1 Metals and Nitrate Sampling

The Subcontractor shall collect 500 gram samples for total metals and nitrate analysis. Each sample shall be a composite sample from all split barrel samples obtained from a specific borehole. The procedure to obtain a uniform composite sample is as follows:

1. Collect split barrel samples for entire hole down to the extent of radiologic contamination, using sampling intervals specified in "Drilling and Sampling Tasks (see Section 8.1, paragraph 3).

2. Longitudinally split the samples and place on clean plastic tarp;

3. Thoroughly mix samples using "cone and quartering" techniques.

4. Place 500 gram sample in sample jar, label, and seal.

Composite metals samples shall be collected for each borehole in the acid, carbonate, and vanadium tailings piles. Approximately 1/2 of the boreholes in the east tailings pile will be sampled. Geotech will determine which boreholes will be sampled.

Discrete samples shall also be collected for metals analysis. Anticipated locations are (1) within the first five feet deeper than extent of radiological contamination outside the tailings piles and (2) at the interface between the alluvial gravels and the bedrock formation beneath the tailings piles. These locations may be modified in the field.

A total of 25 composite and 20 discrete samples will be collected and analyzed. These quantities are subject to change.

Geotech will analyze these samples.

Refer to Section 11.1.1, "Metals and Nitrate Analysis."

8.2.2 Organic Compounds Sampling

The Subcontractor shall monitor all split barrel samples obtained for the presence of organic compounds using sight, and an OVA or HNU meter. Presence of organics is anticipated to be minimal. However, if found, immediately collect four 200-gram samples and seal, one each for BNAs, VOCs, pesticides/PCBs, and herbicides analysis. The VOC sample must be packed tight with no "head" space. Refer to "Test Methods for Evaluating Solid Waste," SW846 Nov. 1986.

Refer to Section 11.1.2, "Organic Compound Analysis."

Geotech will analyze these samples.

8.2.3 Miscellaneous Sampling

A minimum of three 1500-gram samples, one from each material type, shall be collected by the Subcontractor for Ra-226 analysis from each identified borehole in the tailings piles. Approximately every other drill hole will be identified. Only one or two samples are required in the shallow holes outside the tailings piles. One test shall be within 5 feet past the estimated extent of radiologic contamination.

The Subcontractor shall collect 100-gram samples every 10 feet in approximately every other drill hole for pH analysis. Refer to Section 11.1.3, "Miscellaneous Analysis and Testing."

Geotech will analyze these samples.

9.0 TEST PITS

Approximately 16 test pits are anticipated to be excavated for open lithologic logging, in situ testing, obtaining bulk samples, and documenting soil chemistry and radiologic contamination (see Plate 1 for approximate locations). Test pits are located to provide a representative example of the materials in the general area of the test pit, provide construction data for the tailings pile dikes, and to develop a tangible knowledge of excavation methods. Test pits D and M are placed to expose alluvial gravels if depths allow. Locations are subject to change. The Subcontractor is required to

provide a design of the test pits to Geotech for approval prior to construction. It is anticipated that some of the test pits may reach 25 to 30 feet in depth but most will reach 10 to 15 feet in depth. The test pits will comply to OSHA Standards for trench stability. During construction of the test pits, the top two feet of clean cover material shall be stockpiled separate from the excavated material. After backfilling and compacting the pits, replace the cover material on top to pre-excavation conditions.

9.1 Test Pit Sampling

The following tests and samples shall be performed and obtained by the subcontractor from each pit:

- Approximately 6 Shelby Tube samples.
- Approximately 4 five-gallon bulk soil samples. See Section 9.2, "Radon Properties Sampling," for additional sampling for radon emanation testing.

The frequency of testing may be modified based on field conditions.

9.2 Radon Properties Sampling

Assuming the discovery of three distinct material types in each test pit on the tailings piles (sands, slimes, and a mixture of the two), three five-gallon samples, one from each material type, will be collected by the Subcontractor from each sampled test pit. Four three-sample sets are required from each tailings pile. These samples will be used to measure radon diffusion coefficients, radon emanation fraction, and Ra-226 concentration. The Subcontractor will obtain samples from the sides of the test pits. Each five- gallon sample must contain only one distinct material type: sands, slimes, or mixture. In the small tailings piles where only two test pits are planned, obtain three five-gallon samples from two walls of each test pit. The five gallon samples must be sealed and labeled. Refer to Section 11.2.1, "Radon Properties Testing." Consult Section 8.2, "Sampling," for Subcontractor and Geotech responsibilities.

Geotech will analyze these samples.

10.0 DECONTAMINATION OF EQUIPMENT

The Subcontractor shall develop a decontamination plan consistent with CERCLA requirements as part of the work plan.

The Subcontractor's equipment shall be thoroughly cleaned and/or washed prior to commencing any work on this project. This initial decontamination shall be at the Subcontractor's own expense and time. All equipment will be inspected by Geotech Occupational Health and Safety (OH&S) before any drilling, sampling, or installation work is performed. No piece of equipment will be removed from the project site unless it is decontaminated and inspected by Geotech OH&S. In addition, drilling equipment will be decontaminated between each borehole.

Due to the nature of the subsurface materials, all drillpipe, drillrod, augers, bits, samplers, and other downhole tools will be decontaminated after their respective use. Therefore, the Subcontractor shall be prepared to decontaminate any downhole tool(s) after usage.

The Subcontractor shall decontaminate downhole tools in the following manner:

A. The contaminated tools shall be cleaned, using a high-pressure steam cleaner, until all visible contamination is removed.

Items B through E are necessary only if organic compounds were identified in the previous drill hole and, if so, only on sampling tools

B. All tools will be washed with Alconox or approved equal.

C. All tools will be rinsed with water, then distilled water.

D. All tools will be air dried.

E. All tools will be inspected by on-site Geotech personnel before being returned to service.

An area or areas will be designated for equipment and drill rig decontamination operations prior to exiting the site. Anticipate decontaminating downhole tools near the individual drill holes. It will be the Subcontractor's responsibility to erect and maintain a decontamination facility of adequate size and capacity to fully decontaminate rigs and all downhole tools. This facility will be equipped with, but not be solely limited to, such items as a self-powered steam cleaner and water supply, methanol sprayer(s), distilled water sprayer(s), washing and drying racks, containment tank(s) or ponds, overspray protection, ground covers, and clean areas. This facility will be inspected each day by Geotech to insure proper house-keeping and maintenance of the facility.

All decontamination labor is considered incidental to the work. Cost of materials and equipment is a reimbursable expense. The Subcontractor shall dispose of all decontamination fluids and wastes on site as directed by Geotech.

11.0 ANALYSIS AND TESTING TASKS

Geotech's analytical laboratory will perform all analysis on metals, organic compounds, and miscellaneous samples as described in Section 11.1. Geotech's radon laboratory will perform radon properties testing described in Section 11.2.

The Subcontractor shall perform all geotechnical testing required in Section 11.3.

11.1 Geotech Analytical Laboratory

11.1.1 Total Metals and Nitrate Analysis

Geotech's Chemistry Lab will analyze the samples obtained from boreholes for V, U, As, Be, Cd, Cr, Cu, Hg, Mo, Pb, Sb, Se, Zn, Th-230, and NO_3. A hard copy of the data will be provided to the Subcontractor for inclusion in the overall report. Refer to section 8.2.1, "Metals and Nitrate Sampling."

11.1.2 Organic Compound Analysis

Geotech will analyze the samples for BNAs, VOCs, herbicides, and pesticides/PCBs on the TCL. A hard copy of the data will be provided to the Subcontractor for inclusion in the overall report. Refer to Section 8.2.2 "Organic Compounds Sampling".

11.1.3 Miscellaneous Analysis and Testing

Geotech's Chemistry Laboratory will analyze samples for Ra-226 concentration and pH. Geotech will provide a hard copy of the data to the Subcontractor for inclusion in the report. Subcontractor shall assemble pH results into a pH profile. Refer to Section 8.2.3, "Miscellaneous Sampling."

11.2 Geotech Radon Laboratory

11.2.1 Radon Properties Testing

Geotech's radon laboratory will analyze bulk samples obtained from test pits for Ra-226 concentration, emanating fraction, and, if necessary, radon diffusion coefficient. A report analyzing data results will be prepared by Geotech. A hard copy of the report and results will be furnished to the Subcontractor for inclusion in the overall report. This document shall be included as a stand-alone document in an appendix.

The total number of samples is anticipated to be 48. Forty-eight Ra-226 and 96 emanating fraction tests shall be performed on these samples. It is anticipated that 10 radon diffusion coefficient analyses will be necessary.

11.3 Subcontractor Geotechnical Testing

Geotechnical testing may be performed off site per Section 11.3.1.1 or on site per Section 11.3.1.2. The Subcontractor must bid both options.

11.3.1 Location of Testing

11.3.1.1 *Option 1, Off-Site Testing*

Geotechnical testing will be conducted off site in the Subcontractor's laboratory. See section 8.2 for transportation requirements. Transportation documentation shall be submitted to Geotech when samples are returned. Geotech-approved laboratory QA/QC and Health and Safety procedures must be in place for handling radiologically contaminated materials. Geotech approved procedures to decontaminate laboratory areas and equipment must also be present and followed. Submit these procedures within 14 days from notice of award. Geotech reserves the right to conduct unannounced visits to confirm compliance.

All samples shall be returned to Geotech in Grand Junction for permanent disposal at the millsite.

11.3.1.2 *Option 2, On-Site Testing*

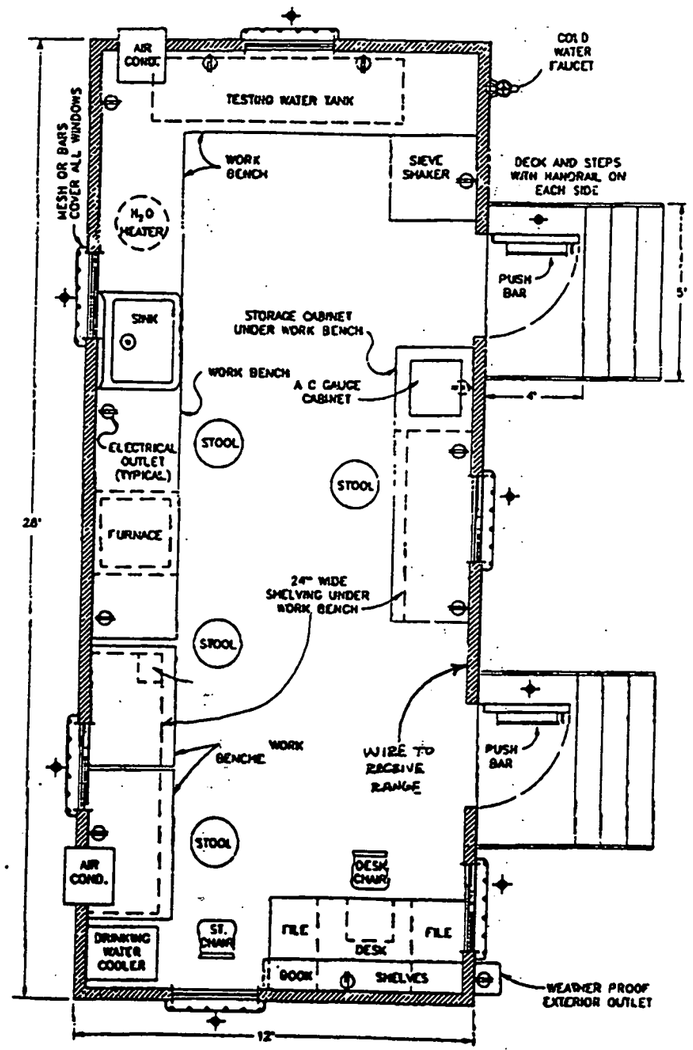
The Subcontractor shall establish a portable geotechnical field laboratory on site at the west entrance to the BLM compound. The trailer and all equipment must be new.

The laboratory shall be a portable trailer as specified by figure 4. Wheels and axles shall remain installed on the trailer. Block and level the trailer and install skirting. Skirting shall be vinyl siding or approved equal. Contractor is responsible for supplying and connecting necessary power and gas.

The laboratory and associated apparatus will become the property of the U. S. Department of Energy and will remain on site.

The laboratory shall include the purchase of all equipment listed in Table-1. Equipment to perform triaxial and shear strength tests is not included. The subcontractor shall transport necessary samples to their lab to perform these tests. Equipment will be inventoried upon delivery to site and upon project completion. All keys shall be submitted to Geotech personnel. The equipment will become property of the U. S. Department of Energy and will remain in the trailer at project completion.

ATTN: BRIAN WILSON
1-248-6495



FLOOR PLAN

M-620-2

GENERAL NOTES

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS APPLICABLE TO THE PROJECT

CLASS 2 FIELD LABORATORIES SHALL CONSIST OF WEATHERPROOF, INSULATED MOBILE HOUSE-TYPE TRAILER WITH FLOOR PLAN AND EQUIPMENT LAYOUT SIMILAR TO THE DRAWINGS ON THIS SHEET AND MEETING THE FOLLOWING MINIMUM REQUIREMENTS:

DIMENSIONS: 28' LONG X 12' WIDE OUTSIDE, 7' HEIGHT INSIDE.

WINDOWS: SIX, 30" X 27", CAPABLE OF OPENING AND LOCKING.

DOORS: TWO, DEADBOLT LOCK EQUIPED, 36" X 80", INSULATED STEEL WITH SMALL CLEAR GLASS WINDOW EQUIPPED WITH HORIZONTAL PUSH BAR, HEAVY DUTY DOOR CLOSERS, AND PULL HANDLE MOUNTED ABOVE PUSH BAR. EACH DOOR SHALL HAVE A SET OF STEPS WITH DECK AND HANDRAILS.

FLOOR: ADEQUATE INSULATION UNDER FLOOR. FLOOR COVERING SHALL BE SKID RESISTANT.

HEATING: FURNACE, 55,000 BTU, FORCED AIR TYPE.

AIR CONDITIONERS: TWO, 6,300 BTU MINIMUM EACH.

ELECTRICAL: WORK SHALL CONFORM TO THE NATIONAL ELECTRICAL CODE FOR 110/220 VOLTS, 60 HZ, APPLICATIONS AND PROVIDE RELIABLE UNIFORM POWER TO PROPERLY OPERATE ALL FIELD LAB EQUIPMENT. PROVIDE A SEPARATE ELECTRICAL CIRCUIT TO SUPPLY POWER TO THE ASPHALT CONTENT GAGE AND THE OUTLET IN THE STORAGE CABINET UNDER WORK BENCH.

LIGHTING: ADEQUATE FLUORESCENT LIGHTING DIRECTLY OVER ALL WORK BENCH AND DESK AREAS.

FURNITURE: TWO, TWO DRAWER, LEGAL SIZE FILE CABINETS BUILT INTO DESK AREA. DESK TO BE BUILT IN WITH ONE CENTER DRAWER. ONE DESK CHAIR WITH ROLLERS. ONE STRAIGHT CHAIR. FOUR STOOLS FOR WORK AREA WITH HEIGHT COMPATIBLE WITH WORK BENCHES.

BOOK SHELVES: MINIMUM 10 LINEAR FEET, 10 INCHES WIDE, BUILT OVER DESK AREA. TOP SHELF TO BE AT LEAST 14" BELOW CEILING.

WORK BENCHES: 30" WIDE X 36" HIGH WITH A DURABLE WORKING SURFACE SUCH AS FORMICA

STORAGE CABINETS: TWO, ONE BUILT-IN UNDER THE WORK BENCH WITH A 26" X 26" LOCK EQUIPPED DOOR, WITH ELECTRICAL OUTLET INSIDE. ONE REMOVABLE, WITH OPEN BOTTOM, LOCK EQUIPPED TO SECURE CABINET TO TOP OF WORK BENCH, LARGE ENOUGH TO COVER A 22" X 16" X 18" HIGH ASPHALT CONTENT GAGE.

SINK: ONE, SINGLE TUB, STAINLESS STEEL, 25" X 22" X 8-1/2" EQUIPPED WITH SPRAY NOZZLE, ONE COMBINATION (MIXING) HOT AND COLD FAUCET AND ONE SINGLE COLD WATER FAUCET. ALL FAUCETS TO BE EQUIPPED WITH STANDARD HOSE THREAD SPIGOTS. DRAIN SHALL HAVE NO TRAP.

DRINKING WATER SUPPLY: DRINKING WATER DISPENSED FROM AN ACCEPTABLE WATER COOLING DEVICE.

TESTING WATER SUPPLY: 300 GALLON WATER CAPACITY, IN ONE OR MORE TANKS LOCATED ALONG THE TRAILER END OR ALONG BOTH SIDES AT THE TRAILER END, VENTED, WITH MEANS OF DETERMINING WATER LEVEL, WITH ONE PRESSURE PUMP, MINIMUM 30 PSI DELIVERY PRESSURE, TEN GALLON ELECTRIC WATER HEATER, ONE COLD WATER FAUCET LOCATED ON OUTSIDE OF TRAILER AS SHOWN. WATER PIPES SHALL BE LOCATED TO BE UNEXPOSED AND PROTECTED FROM DAMAGE. WATER SHALL BE SUPPLIED BY THE CONTRACTOR.

TELEPHONE: MINIMUM FLAT RATE SERVICE FROM NEAREST EXCHANGE.

FIRE EXTINGUISHER: ONE, NON-TOXIC, DRY CHEMICAL, MEETING UNDERWRITERS LABORATORIES, INC. APPROVAL FOR 10 LB. CLASS ABC WITH 20BC RATING.

SIEVE SHAKER: ONE, MOTOR DRIVEN, STANDARD PORTABLE, CAPABLE OF HANDLING A SET OF 8" U.S. STANDARD SIEVES, MOUNTED 24" ABOVE FLOOR IN A SOUND-PROOF, INSULATED ENCLOSURE HAVING A HINGED DOOR.

BALANCES: TWO, A 2,610 GRAM DIAL-A-GRAM BALANCE THAT MEASURES TO 0.1 GRAM ACCURACY, AND A 20,000 GRAM BALANCE THAT MEASURES TO ONE GRAM ACCURACY.

✦ SECURITY: THIS SYMBOL ON THE FLOOR PLAN DENOTES AREAS ON THE LABORATORY WHERE ADEQUATE PROTECTION AGAINST ILLEGAL ENTRY, VANDALISM AND THEFT SHALL BE PROVIDED.

THE REQUIREMENTS LISTED HEREIN ARE INTENDED TO MEET THE NEEDS OF DIVISION OF HIGHWAYS TESTING PERSONNEL CONCERNING TESTING FACILITIES. THERE IS NO INTENT TO SPECIFY ANY STRUCTURAL PORTIONS OF THE SUBJECT LABORATORY EXCEPT AS NEEDED TO SATISFACTORILY PERFORM THE REQUIRED TESTING OF MATERIALS. THE OMISION DISCLAIMS ANY RESPONSIBILITY FOR THE QUALITY OF THE STRUCTURE.
THE WINDOW SIZES AND LOCATIONS ON TRAILERS BUILT IN ACCORDANCE WITH M-620-2 DATED JAN. 1982 WILL BE ACCEPTED.

REVISIONS

FIELD LABORATORY

DATE REVISED	APPROVED BY: STAFF DESIGN ENGINEER DATE: MAY 23, 1988	STANDARD PLAN NO. SHEET 1 OF 1

FIGURE 4

TABLE-1

ITEM	QUANTITY	DESCRIPTION
1	1	"Speedy" Moisture Tester
2	1 carton	Reagent
3	1 dozen	Tin Sample Box, 3 oz.
4	1 dozen	Tin Sample Box, 8 oz.
5	1 pair	Laboratory Tongs
6	1 pair	High Temp Gloves
7	1	Spatula
8	1	Density Drive Sampler, 3"
9	1 set	3" Diameter Drive Tubes, set of 10
	SIEVES, 8" DIAMETER FULL HEIGHT, BRASS FRAME, SS MESH	
10	6 Total	Sieve Mesh Sizes 4" thru #80, PCF-8 Series
11	1	#100
12	1	#200
13	1	Pan
14	1	Cover
15	1	Fine Sieve Brush
16	1	Wire Sieve Brush
17	1	Wet Washing Sieve, 8" x 4"
18	1	Wet Wash Spray Attachment
	HYDROMETER GRAIN SIZE ANALYSIS	
19	1	Stirring Apparatus
20	6	Hydrometer Jar
21	1	Hydrometer, 151H
22	1	Hydrometer, 152H
23	6	Sodium Hexametaphosphate, 1 lb.
24	3	Glass Beaker, 250 ml.
25	2	Thermometer, Dual Scale
26	1	Stop Watch

ITEM	QUANTITY	DESCRIPTION
		SPECIFIC GRAVITY
27	6	Volmetric Flask, 250 ml.
28	1	De-Airing Stand
29	1	Vacuum Pump
		ATTERBERG LIMITS
30	1	Liquid Limit Set
31	1	Plastic Limit Set
		TORVANE
32	1	Torvane Set
		CONSOLIDATION
33	2	Terraload Consolidation Device
34	2	Floating Ring consolidometer for 2.5" Diameter Specimens
35	2	Dial Indicator
		PERMEABILITY-CONSTANT HEAD
36	3	Flexible Wall Permeater for 2.8" Diameter Samples
37	1	Bladder Accumulator
38	1	Triax/Permeability Control Panel
39	1	Double Panel (Add-on) for 6 Pressure Position
40	1	De-Airing Water Tank
41	1	Nold Deaireator Water System
		PERMEABILITY-FALLING HEAD
42	4	Combination Permeameter, Fixed Wall, for 2.5" Diameter Specimens
43	1	Miniature Permeameter Set

ITEM	QUANTITY	DESCRIPTION
		PROCTOR EQUIPMENT
44	1	Standard Compaction Hammer (manual)
45	1	Modified Compaction Hammer (manual)
46	1	Standard Compaction Mold
47	1	Modified Compaction Mold
48	2	Straight Edge
49	2	Plastic Dispensing Bottle
		BULK GRAIN SIZE
50	1	Gilson Mechanical Test Shaker w/five (5) coarse series screen trays and pan
51	3	Additional screen trays, 4" thru #4 mesh
		PINHOLE DISPERSION
52	1	Pinhole Dispersion Test Apparatus
		GENERAL LABORATORY EQUIPMENT
53	1	Forced Draft Oven, 120V 60HZ
54	1	3-Wire Cord and Plub
55	1	Dial-O-Gram Balance, 2610 gm x 0.1 gm
56	1	Solution Balance, 20 kg x 1 gm
57	1	Electronic Balance, Dual Scale, 800 gm x 0.1 gm & 800 gm x 0.01 gm
58	1 lot	Miscellaneous Plastic Ware including Beakers, Graduated Cylinders, and Dispensing Bottles
59	1 lot	Miscellaneous Thermometers, Glass & Metal Stem
60	1 lot	Miscellaneous Hand Tools, Spatulas, Trimming Knives, etc.

All geotechnical testing must be performed on site within the contaminated area. The QA/QC and Health and Safety procedures listed in Option 1 must be followed for this option as well. However, equipment decontamination procedures are not required. Except as stated above, no geotechnical samples will be permitted to leave the contaminated area. Dispose of samples on site as directed by Geotech.

11.3.2 Soils Testing

The Subcontractor shall design and perform a soil sampling/testing program that will provide data for contaminated materials geotechnical characterization.

The soils laboratory performing this work will have a written and implemented Quality Assurance/Quality Control Plan approved by Geotech prior to work. Actual sample locations per borehole are not specified and shall be determined in the field by the Subcontractor. Tests are listed by common industry name. See Section 21.0 for available ASTM methods. The number and types of testing anticipated are listed below.

400	Moisture Content
40	Natural Density
30	Manual Grain Size Analysis
40	Hydrometer Grain Size Analysis
20	Specific Gravity Tests
40	Atterberg Limits Test
20	Capillary Moisture Rise Fine Grained Soils
18	CIU w/PP Triaxial Points (3 curves)
30	Unconfined Compression
18	Direct Shear
36	Torevane Shear Test Downhole End of Each Tube (in field)
10	1-D Consolidation Test (minimum 6 loads each)
16	Constant Head Permeability with BP/Saturation "B Value$\geq$ .95"
8	Falling Head Permeability
16	Standard Proctor Moisture Density Capacity Tests
16	Modified Proctor Moisture Density Compaction Tests
16	Bulk Grain Size
3	Pinhole Dispersion Tests
6	Moisture Characteristic Curves
	*Moisture Content vs. Head (soil water potential)
	*Hydraulic Conductivity vs. Head (soil water potential)

These tests shall be performed in accordance with ASTM standards when applicable. In the event that procedures for sampling or laboratory testing are implemented and do not have an applicable ASTM standard, the procedures shall first be approved by Geotech prior to implementation and secondly be described in full in the final report. Laboratory test results shall be fully reduced and presented in both graphical (where applicable) and tabular formats.

12.0 APPLICABLE FIELD AND LABORATORY ASTM STANDARDS

All drilling, sampling, and laboratory work shall be done in accordance with the most relevant ASTM standard as identified in the current book of ASTM Standards, Volume 04.08.

The applicable ASTM standards shall include but not be limited to:

Field:

ASTM D 653	Terms and Symbols Relating to Soil and Rock
ASTM D 1452	Practice for Soil Investigation and Sampling by Auger Borings
ASTM D 1586	Method for Penetration Test and Split Barrel Sampling of Soils
ASTM D 1587	Practice for Thin-Walled Tube Sampling of Soils
ASTM D 2488	Description and Identification of Soils (visual - manual procedure)
ASTM D 4220	Preserving and Transporting Soil Samples
Nonstandard	Use of Torevane Field Shear Strength Device
Nonstandard	Use of Pocket Penetrometer

Laboratory:

ASTM D420	Recommended Practice for Investigating and Sampling Soil and Rock for Engineering Purposes
ASTM D421	Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D422	Particle-Size Analysis of Soils
ASTM D698	Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. (2.49 kg) Rammer and 12-in. (305-mm) Drop
ASTM D854	Test for Specific Gravity of Soils
ASTM D1140	Test for Amount of Material in Soils Finer than the No. 200 (75-μm) Sieve
ASTM D1557	Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D2166	Test for Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D2217	Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D2325	Test for Capillary-Moisture Relationships for Coarse and Medium-Texture Soils by Porous Plate Apparatus
ASTM D2434	Test for Permeability of Granular Soils (Constant Head)
ASTM 24435	Test for One-Dimensional Consolidation Properties of Soils
ASTM D2487	Test for Classification of Soils for Engineering Purposes
ASTM D3080	Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D3152	Capillary-Moisture Relationships for Fine Textured Soils by Pressure-Membrane Apparatus
ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4647	Identification and Classification of Despersive Clay Soils by the Pinhole Test

13.0 REPORT

While this program is independent of previous investigations and includes many new facets, the level of detail should be similar to the outline in Appendix F. The final report shall include at a minimum but not be limited to

A detailed Physical, Geotechnical, and Extent-of-Saturation Description of Site
A detailed Description of Field Activities
- Auger Borings
- Test Pits
- Photographic Record of Test Pits
- Observation Well Completion Data
- Observation Well Development Data
- Observation Well Recovery Data - Reduced
- Geologic and Contamination Cross-Sections (show layering of material types)

A detailed Description of Laboratory Testing
- Non ASTM testing procedures
- Typed and Drafted Tabulated and Graphical Format, Where Applicable
- Classification Data
- Strength Data - In Situ and Remolded Where Appropriate
- Consolidation Data - In Situ and Remolded Where Appropriate
- Radon Testing Data

Construction Data - Bulk Density; In Place Density; Compaction Characteristics; Cross Section of Radiologic Contaminated Material Locations

Miscellaneous Data - Including Groundwater Elevation Data, Unsaturated Soil Moisture Characteristics and Curves, and typed and drafted Boring Logs.

Professional Interpretation of the Extent, Type, and Concentration of Contaminants. This interpretation shall include an analysis of data provided by Geotech to the Subcontractor in Sections 8.1.3 and 11.1 and identification of design and construction issues that may be encountered in excavating contaminated materials from the millsite and placing and compacting in the repository

14.0 QUALITY ASSURANCE

The Subcontractor, and all lower tier subcontractors, shall have in place a Geotech approved QA Plan prior to commencement of any work on this project. Submit this plan within 14 days of notice of award. For QA Plan Requirements see Appendix E.

15.0 HEALTH AND SAFETY

All applicable federal, state, county, and city safety regulations and practices shall be strictly adhered to at all times. These regulations and practices shall include, but are not solely limited to, the wearing of approved safety hats, shoes, and glasses. No unauthorized personnel, firearms, personal pets, illegal drugs, or alcoholic beverages will be allowed on the project area. All personnel will be required to review, acknowledge understanding, and comply with the attached Health and Safety Plan by signing the Acknowledgement Signature page (see Appendix D). Lower-tier Subcontractors are also required to meet all requirements of this section. Daily safety meetings must be conducted and attendance and topic documented! Submit documentation of these meetings to the Geotech technical monitor weekly.

Geotech shall be partly responsible for operational health and safety coverage during the drilling activities. This will include the issuance of coveralls, gloves, and bootcovers for workers. It will also include the issuance of respirators, if required. Geotech shall be responsible for airborne radioparticulate monitoring. The Subcontractor will be responsible to monitor Subcontractor personnel for organics, metals, PCBs, and silica exposure. All Subcontractor personnel shall adhere to the Geotech Operational Health and Safety (OH&S) regulations as outlined in Appendix D.

The Subcontractor will be required to submit a written Health and Safety plan stating their Health and Safety program and implementation plan within 14 days from notice of award. The Subcontractor shall designate a health and safety representative.

Geotech requires a physician's statement certifying the completion of the medical surveillance described in Appendix D. In addition, all Subcontractor personnel must be able to wear full mask-filtered respirators on demand. This will exclude personnel with beards from working on the project. Also, no smoking, eating, or chewing will be allowed except in designated areas.

16.0 PERSONNEL

16.1 Qualifications

The Subcontractor's lead Project Technical Manager must hold current professional registration as a Civil Engineer (PE) with the State of Utah and have a minimum of ten (10) years of investigation and environmental professional experience. A licensed Geotechnical Engineer (PE) with a minimum of four (4) years experience in subsurface exploration shall be present on site to maintain and direct site exploration activities. The geotechnical engineer shall direct sampling, logging the drill holes and in situ testing; shall care for samples and the central chain-of-custody records; and shall maintain daily records of field activities.

16.2 Training

All personnel working on the site will be required to have the 40-hour OSHA training for Hazardous Substances, Worker Protection as mandated by SARA, 1986, and 8-hour radiation worker training mandated by DOE Order 5480.11. The radiation worker training will be provided by Geotech in Grand Junction at no cost for coarse fee. It must be scheduled two weeks in advance. Refer to the Health and Safety plan, Appendix D, for further training and documentation requirements. The Subcontractor is required to submit documentation of all Subcontractor furnished training to Geotech before commencement of work.

17.0 ADDITIONAL SCOPE OF WORK

In accordance with the "Changes" clause (17.0 of the Terms and Conditions for Drilling Subcontracts), Geotech may authorize additional work or changes, within the scope of work of this subcontract, to be performed as required during the period of performance of this subcontract.

If the Subcontractor considers any technical direction by the Technical Monitor as being a change in the work affecting the overall price or performance period or any other requirements of this subcontract, he/she shall immediately advise the Subcontract Administrator and the Technical Monitor giving full details.

Should additional work be authorized, the enclosed Supplemental Schedule of Fees supplied by the Subcontractor shall apply. Geotech reserves the right to negotiate the unit rates prior to award of additional work, if it is determined the rates are unfairly weighted.

18.0 LOWER TIER SUBCONTRACTORS

A list of lower-tier subcontractors shall be submitted at the time of the bid. Inform Geotech immediately of any changes.

All lower-tier subcontractors will be required to fulfill all requirements of this statement of work.

19.0 WORK BY OTHERS

Geotech may perform additional work related to the project. In addition, other subcontracts may be implemented on site during performance of this subcontract. Subcontractors shall coordinate their activities with Geotech and each other, to alleviate interference.

20.0 SUMMARY OF SUBMITTALS

SECTION	ITEM	DUE DATE
5.0	State of Utah Water Well Drillers License	Prior to work
5.0	Drilling licenses	Prior to work
7.0	Work Plan	14 days from Notice of Award (NOA)
8.1.1	Drilling Fluids	Prior to use
8.1.1	Drilling Lubricants	Prior to use
8.1.2	Typed and drafting boring logs	Final report
8.1.2	Copy of field log	At completion of each borehole
8.1.2	Daily driller's logs	Weekly
8.1.3	Auger flights for logging calibration	2 weeks before work begins
8.1.6	Mandatory Minimum Equipment	With proposal
8.2	Sampling Plan	With work plan
8.2	Transportation plan	With work plan
8.2	Manifests and associated shipping documents	Prior to work with samples
9.0	Test pit design	Prior to construction
10.0	Decon plan according to CERCLA	With work plan
11.3.1	Soils lab QA/QC program	14 days from NOA
11.3.1.1	Sample return to Geotech	Upon completion of test
11.3.1.1	Manifests and associated shipping documentation	Return with samples
11.3.2	Non ASTM sampling or lab testing proceed	Prior to implementation
14.0	QA Plan (subs and lower tiers)	Prior to work
15.0	Health & Safety Plan	14 days from NOA
15.0	Daily safety meeting documentation	Weekly
15.0	Appendix D - Physician's Statement	Prior to work

SECTION	ITEM	DUE DATE
16.0	Training documentation	Prior to work
18.0	List of Subcontractors	Time of bid
19.0	Draft interpretive report	70 days from work plan approval
19.0	Final report (10 copies)	21 days after return of Geotech review
21.0	Work schedule (bar chart)	With proposal

See Appendix D for additional submittals.

21.0 PERIOD OF PERFORMANCE

The period of performance of this subcontract is from approximately April 1991 to August 1991. The Subcontractor's proposed work schedule (Barchart form) shall be submitted at the time of proposal. Once approved, this work schedule may be altered only by written approval of the Geotech Technical Monitor. Changes shall be submitted in writing to the Technical Monitor 10 days prior to the desired change.

The Subcontractor's work plan, health and safety plan, and QA/QC plan shall be submitted for Geotech approval within 14 days after notice of award.

Exploration shall begin 7 days from date of approved work plan and be completed in 40 days from that date. The Subcontractor shall not be compensated nor penalized for delays caused by weather. Spring time conditions should be anticipated. Laboratory testing shall begin 17 days from work plan approval date and be completed 50 days from that date. Drilling shall begin on the tailings piles first with tests pits being dug as soon as drilling information confirms test pit locations, preferably within one week.

A Draft Detailed Interpretive Geotechnical Soils and Groundwater Report shall be completed 70 days from date of work plan approval.

The Subcontractor shall submit ten copies of the final Report within 21 days after Geotech returns reviews of the draft report to the Subcontractor. Throughout the entire performance period of this contract the Subcontractor will provide preliminary drilling logs and laboratory data as required by Geotech to guide design decisions. Also, refer to submittals section for a summary of required submittals and times.

22.0 PROJECT PROGRESSION

Drilling shall begin on the tailings piles first. Excavation of test pits shall begin within 7 days after drilling begins. All investigation shall be completed on and around the tailings piles before moving to other areas. Samples shall be transported to Geotech in Grand Junction as soon as possible.

23.0 PROJECT START-UP MEETING

An orientation meeting will be conducted on site before work commences. Representatives from Geotech and the Subcontractor will attend. Items of discussion include

- Chain of Command (all parties)
- Submittals
- Ensure proper documentation
- Special items of concern

The time and place will be arranged.

APPENDIX A

Monticello Millsite
Geology

APPENDIX A

GEOLOGY

The following section is taken from the draft millsite Remedial Investigation report dated April, 1989. It is for information purposes only and may not be representative of the actual drilling conditions.

4.2 GEOLOGY

4.2.1 Regional Setting

The Monticello millsite is situated in the southern part of the Canyonlands section of the Colorado Plateau physiographic province. Two major landscape features dominate the region: the broad, nearly flat upland surface known as the Great Sage Plain and the deeply incised canyon network of Montezuma Creek and its tributaries (Figure 4-4). Five miles west of Monticello, the Abajo Mountains rise approximately 5,700 ft above the Sage Plain and are the most conspicuous feature on the western horizon.

The Colorado Plateau is characterized by a diverse assemblage of tectonic elements (Figure 4-5). Monticello, which lies near the center of the Colorado Plateau, is located in the Paradox basin, just east of the Abajo dome, near the boundary between the Paradox fold and fault belt and the Blanding basin. The region is underlain by a thick sequence of Paleozoic and Mesozoic sedimentary rocks which mainly dips less than 10 degrees and rests on a Precambrian crystalline basement. A generalized stratigraphic section of pre-Cenozoic rock units typical of the project area is shown in Figure 4-6. Dips locally exceed 10 degrees where the sedimentary rocks are involved in fold and fault structures that trend mainly northwestward in the Paradox fold and fault belt. These structures were formed primarily during late Paleozoic and Mesozoic time by diapiric movement of thick salt deposits in the Paradox Member of the Hermosa Formation of Pennsylvanian age.

Sedimentary rocks exposed east of the Monument upwarp (Figure 4-5) in Utah are mainly of Mesozoic age. Tertiary sedimentary rocks either were not deposited in this area or were removed by erosion during regional uplift of the Colorado Plateau during late Tertiary time. The Abajo Mountains, located 5 to 10 mi west of the project area, are composed of a cluster of laccoliths of Oligocene age. These laccoliths are made up of porphyritic rocks, mainly diorite and quartz diorite (Witkind, 1964). Surficial deposits of Quaternary age, consisting of pediment gravels, alluvium, and loess, cover much of the Mesozoic sedimentary rocks east of the Abajo Mountains.

4.2.2 Site Geology

The project area is less than 1 square mile in size and is located in the valley of Montezuma Creek approximately 0.25 mi south of the City of Monticello. Sedimentary rocks that underlie the area dip gently (from less

than 1 to 1.4 degrees) to the northeast, away from the Abajo Dome and toward the Monticello syncline. The axis of the Monticello syncline, located about 1 mi north of the project area, trends and plunges gently to the east (Haynes and others, 1972).

The valley of Montezuma Creek was cut, during Pleistocene and more recent times, through Pleistocene pediment gravels into the underlying bedrock of Mancos Shale, which is of Late Cretaceous age. The creek has cut through the Mancos Shale in several places into the middle part of the Dakota Sandstone, also of Late Cretaceous age. The Lower Cretaceous Burro Canyon Formation, composed mainly of thick sandstone, underlies the Dakota Sandstone; it is exposed only near the eastern end of the project area. Mudstones of the Brushy Basin Member of the Morrison Formation of Late Jurassic age underlie the Burro Canyon Formation but are not exposed in the project area. The bedrock formations described here are those directly relevant to addressing potential contamination to the subsurface environment.

Exposed bedrock formations and Quaternary units are delineated on the geologic map of the project area (Figure 4-7). The bedrock formations mentioned above, from oldest to youngest, and the overlying Quaternary deposits are described in the paragraphs that follow. Much of the detailed information on which this section is based is derived from 82 boreholes drilled during the past several years, from a seismic survey to determine thickness of unconsolidated surficial deposits, and from petrographic studies.

4.2.2.1 Brushy Basin Member

The Brushy Basin Member is the upper of the two members of the Morrison Formation in this area. It consists of variegated gray, pale-green, red-brown, or purple bentonitic mudstone and minor conglomeratic sandstone. The Brushy Basin represents mainly floodplain deposits and is several hundred feet thick.

4.2.2.2 Burro Canyon Formation

The Burro Canyon Formation overlies the Brushy Basin Member of the Morrison Formation. Intertonguing of Burro Canyon sandstones with Brushy Basin mudstones was observed in core from Drill Hole 70, which indicates that the contact is conformable in the project area (see Figure 4-8 for drill-hole locations). The Burro Canyon represents continental deposits of coarse fluvial sandstone and minor overbank mudstones in interfluve areas. Sandstones constitute more than 90 percent of the formation in the project area. They are light-colored, highly quartzose, and are cemented mainly by calcite (Craig, 1981). The sandstone units represent a crude sedimentation cycle, beginning with a scour surface at the base that is filled with coarse sandstone and cross-stratified conglomeratic sandstone. This sequence becomes finer grained and parallel-bedded as it grades upward to the beginning of the next cycle (Craig, 1981).

Mudstones in the Burro Canyon Formation range from silty to sandy and are predominantly greenish-gray in color. Clay minerals present in the mudstone are generally nonswelling, which distinguishes them from the swelling mudstones of the Brushy Basin Member.

Huff and Lesure (1965) note that the upper 20 to 25 ft of the Burro Canyon Formation is generally silicified in the Montezuma Canyon area to the east and southeast of the project area. This silicified zone is probably the remnant of an ancient soil horizon which formed during a long period of weathering following Burro Canyon deposition (Huff and Lesure, 1965). The zone is evidently not present in the project area, because it was not encountered in core from drill holes that penetrate the Dakota/Burro Canyon contact. An extensive fractured zone at the Dakota/Burro Canyon contact in Drill Hole 70 may represent this erosional Burro Canyon surface. The long period of weathering following deposition of the Burro Canyon and prior to Dakota deposition is evidenced in the project area largely by the undulatory nature of the contact between the two units. This irregular surface can be seen in the generalized cross section (Figure 4-9) and is probably a function of both pre-Dakota weathering and Dakota channel cutting.

The Burro Canyon Formation is approximately 115 ft thick in core taken from Drill Hole 70. This thickness agrees with the results of a study conducted by Craig (1982) which revealed approximately 130 ft of Burro Canyon in the project area.

4.2.2.3 Dakota Sandstone

The Dakota Sandstone disconformably overlies the Burro Canyon Formation and exhibits a variety of lithologies including conglomerate, sandstone, siltstone, mudstone/claystone, carbonaceous shale, and low-grade coal. In the project area, the Dakota consists of a succession of conglomerate and sandstone at the base; carbonaceous siltstone, shale, claystone, thin sandstone layers, and low-grade coal in the middle; and massive medium-grained sandstone at the top. The basal sandstones and conglomerates are of fluvial origin. The carbonaceous middle part of the formation represents a paludal or backwater/swamp depositional environment with dense vegetation. The upper sandstone beds in the formation represent transgressive littoral or offshore marine deposits which grade upward into dark marine shales of the Mancos Shale.

The coarse sandstone and conglomerate at the base of the Dakota fill channels cut into the underlying Burro Canyon. These lower beds, as well as the rest of the Dakota, are distinguished from the Burro Canyon by leaf impressions, carbonaceous debris, and dark-gray shales. Impure bituminous coal beds, up to several feet thick in the lower and middle parts of the Dakota, are encountered in core from many of the drill holes. Relatively impermeable siltstones are common in the middle Dakota and tend to be blocky and more resistant to weathering than claystones. One layer of siltstone that is several feet thick appears to be laterally continuous across much of the project area (Plate 4-6).

Thin, medium-grained, cross-bedded sandstones of the middle Dakota are exposed for about 700 ft in the man-made-channel portion of Montezuma Creek, just south of the East Tailings Pile (Figure 4-7). Sandstone beds in the Dakota are commonly composed of smaller cross-bedded units, 0.5 to 2 ft thick (Huff and Lesure, 1965). Cross beds in sandstones of the middle Dakota south of the East Tailings Pile strike N. 10° W. and dip approximately 25° E. Jointing is common in the sandstone of the Montezuma Canyon area along the cliff faces and probably happened after canyon development as a result of subsidence of weaker rocks underneath (Huff and Lesure, 1965). More recently exposed outcrops of Burro Canyon sandstones along Montezuma Creek (Figure 4-7) appear as massive, uniform layers that have no apparent jointing. Throughout the 700 ft of Dakota outcrop in the creek bottom, only two fractures were observed on the Montezuma Creek channel floor. These fractures show no displacement and are not continuous to the outcrop along the edge of the creek. They may be related to the recent unloading of Dakota Sandstone during construction of the man-made channel. No evidence of local faulting was found through correlation of core from the project area or from examination of Dakota/Burro Canyon outcrops east of the site.

Young (1960) indicated that the Dakota Sandstone near Monticello is approximately 100 ft thick. This agrees with core data from Drill Holes 50 and 34A which indicate a total Dakota thickness of just greater than 100 ft. However, as shown on the inferred subcrop map (Figure 4-10) and on the fence diagram (Plate 4-6), some of the Dakota in parts of the project area has been removed by erosion during downcutting of the Montezuma Creek valley. As a result, the Dakota decreases in thickness toward the east (downstream), toward the north from the southern part of the project area, and toward the south from the northern part of the project area (toward the creek, Plate 4-6). Only 37 ft of Dakota (including 22 ft of relatively impermeable middle Dakota shales, claystones, and siltstones) is present in Drill Hole 70, just east of the Government property. The Dakota has been completely removed from Montezuma Canyon 2400 ft downstream from Drill Hole 70, near Drill Hole 56 (Figure 4-10).

4.2.2.4 Mancos Shale

The contact of the Dakota Sandstone and the overlying Mancos Shale is conformable and gradational. The Mancos is composed mainly of medium- to olive-gray silty shale. Only remnants of the lower Mancos exist below a cover of pediment gravels. Approximately 300 ft of Mancos is exposed, primarily along the sides of the valley of Montezuma Creek south of Monticello (Huff and Lesure, 1965). Exposure of Mancos Shale along Montezuma Creek in the project area occurs immediately east of U.S. Highway 191 for a distance of approximately 100 ft.

Shales of the Mancos locally grade into fine-grained, thin-bedded, blocky limestone, particularly in several zones 20 to 50 ft above the base of the formation (Huff and Lesure, 1965). These limestone beds are fossiliferous and are the expression of the Greenhorn Limestone Member of the Mancos Shale, which is well developed to the southeast in the San Juan Basin (Molenaar, 1975).

4.2.2.5 Unconsolidated Surficial Deposits

Pleistocene pediment gravels, shed as alluvial fans from the Abajo Mountains, form an extensive cap over Mancos Shale on the upland surfaces of the project area. The gravels consist mainly of unsorted cobbles of diorite porphyry, hornfels, and silicified sandstone set in a finer-grained matrix of sand, silt, and clay.

A veneer of reddish-brown loess composed of silty sand covers the upland pediment surfaces north and south of the Montezuma Creek valley. This feature reflects Holocene deposition of aeolian material, borne by prevailing south-westerly winds. The loess is probably abundant in the alluvium of Montezuma Creek, particularly along the southern edge of the valley.

Other fine-grained Holocene material in the project area is found in alluvium along the present course of Montezuma Creek and in strath terraces that occur predominantly to the north of the creek, approximately 20 ft above stream level. The strath terraces are covered by a thin veneer of gravel similar in composition to the older pediment gravels.

The alluvial deposits along Montezuma Creek constitute one of two aquifers in the project area. They rest directly on various parts of the Dakota Sandstone throughout most of the millsite area except at the western edge, where the alluvium rests on the eroded surface of the Mancos Shale (Figure 4-9). In the tailings area, the alluvial deposits consist of a heterogeneous assemblage of gravel, sand, silt, and minor clay. The alluvial sequence is locally in excess of 20 ft thick but is much thinner in most places.

APPENDIX.A:SOWGEOTECH89:OA

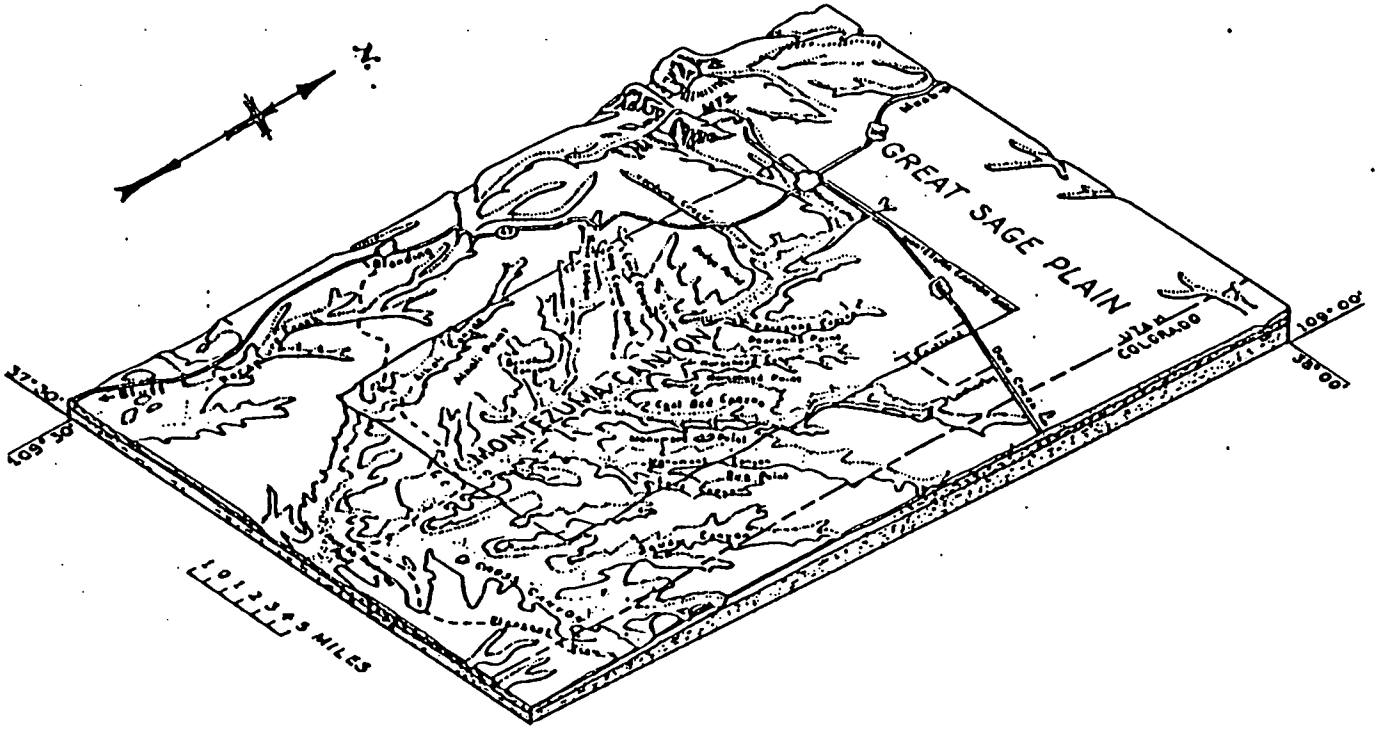


Figure 4-4. Terrain Diagram of the Montezuma Canyon Area, San Juan County, Utah (from Huff and Lesure, 1965)

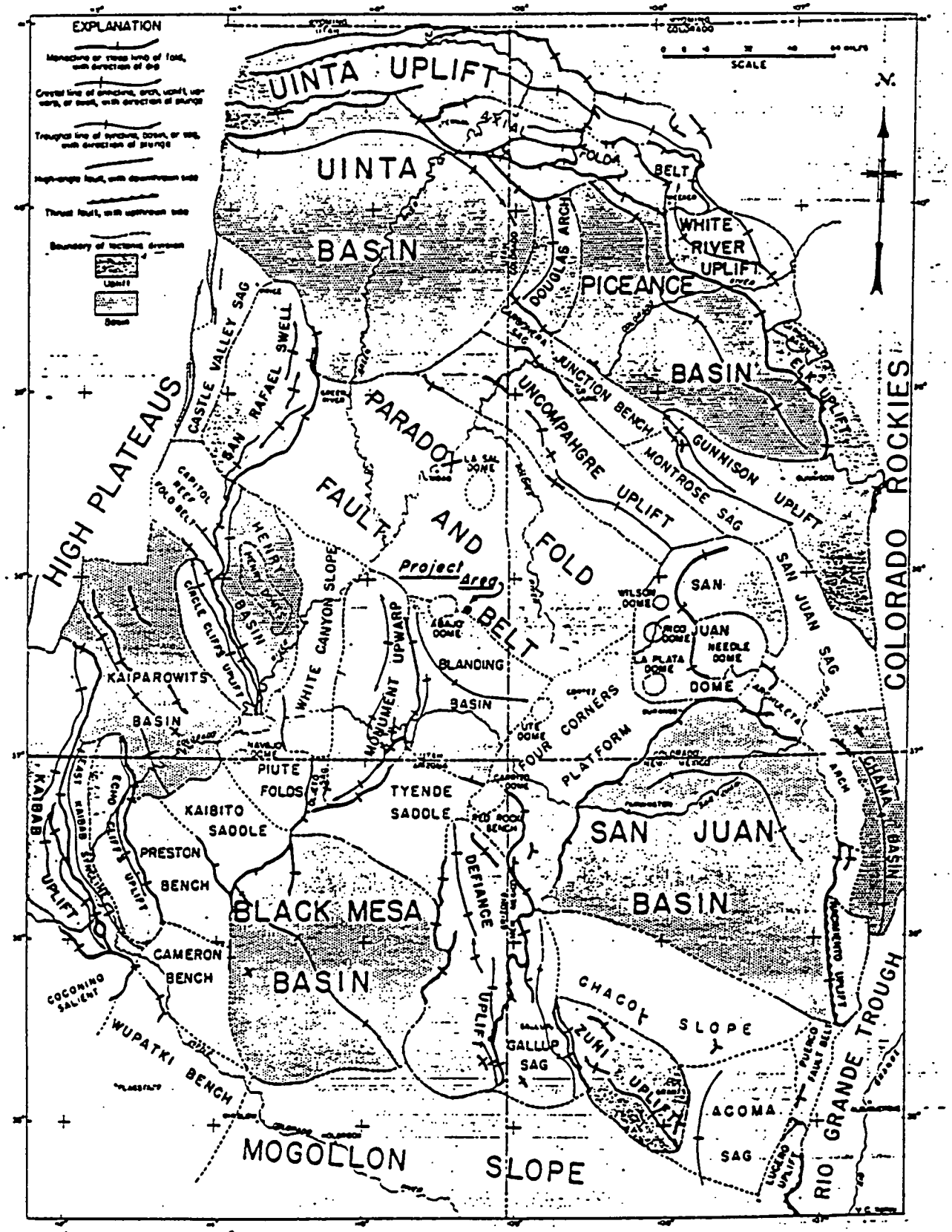


Figure 4-5. Tectonic Setting of the Monticello Project Area

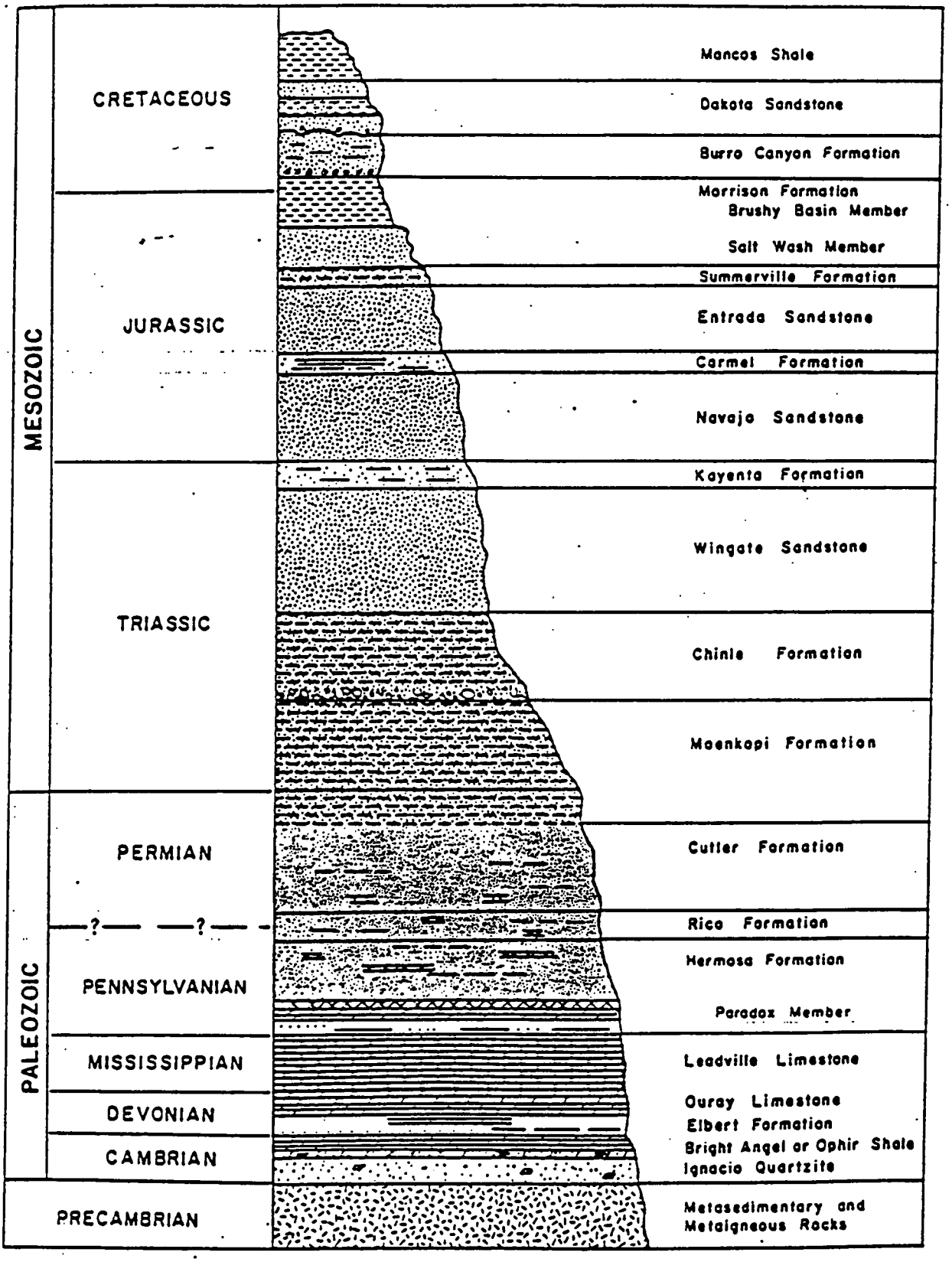
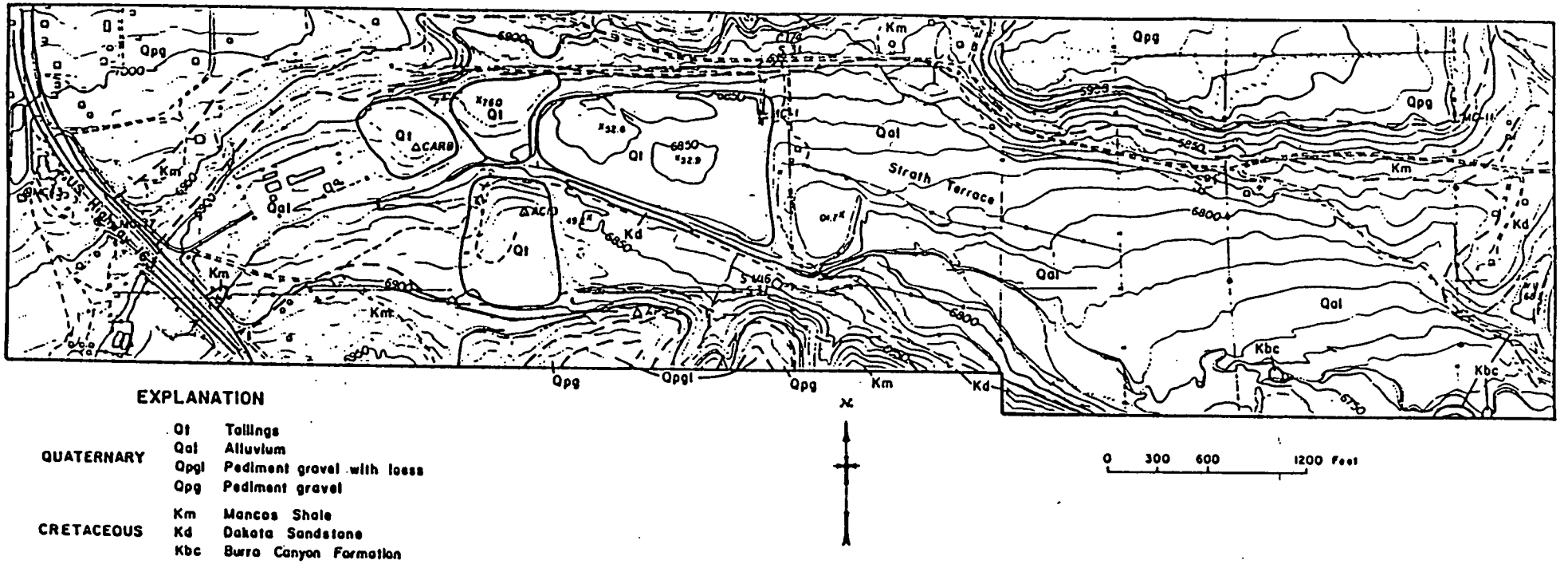


Figure 4-6. Generalized Bedrock Stratigraphy of the Monticello Area

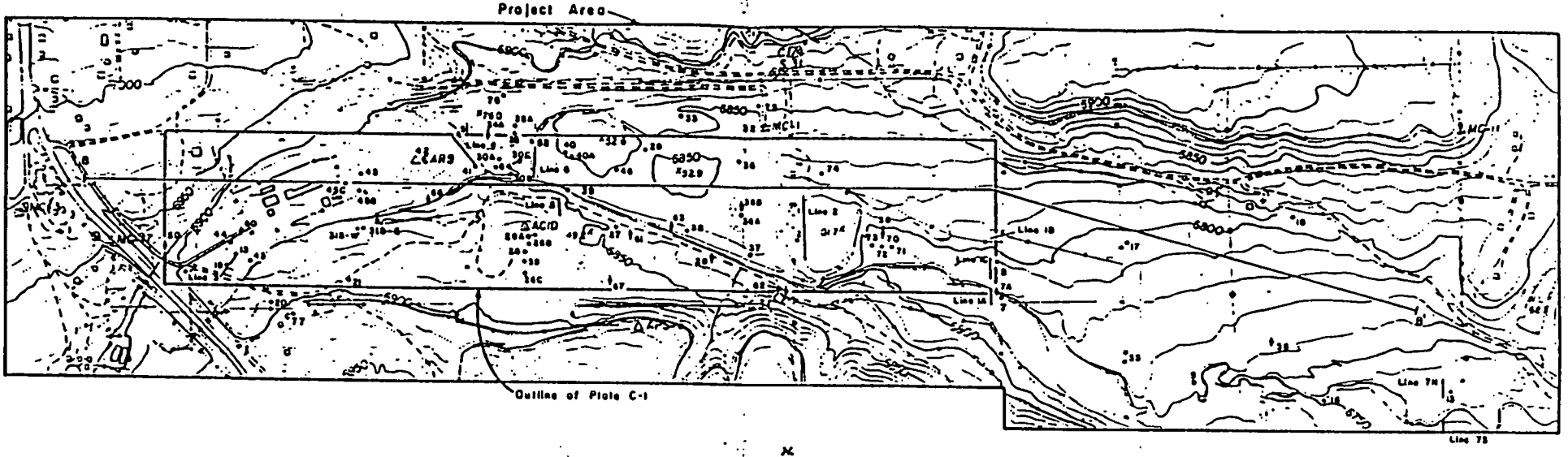


EXPLANATION

QUATERNARY	Qt	Tailings
	Qal	Alluvium
	Qpgl	Pediment gravel with loess
	Qpg	Pediment gravel
CRETACEOUS	Km	Mancos Shale
	Kd	Dakota Sandstone
	Kbc	Burro Canyon Formation

Contact (dashed where inferred)

Figure 4-7. Geologic Map of the Project Area



EXPLANATION

B-B' Generalized Cross Section

Line I Seismic-Refraction Line

Drill Hole

Core Hole

Abandoned Drill Hole

Figure 4-8. Locations of Bore Holes, Seismic-Refraction Lines, and Cross Section B-B' (See Figure 4-9 for generalized west-east cross section.)

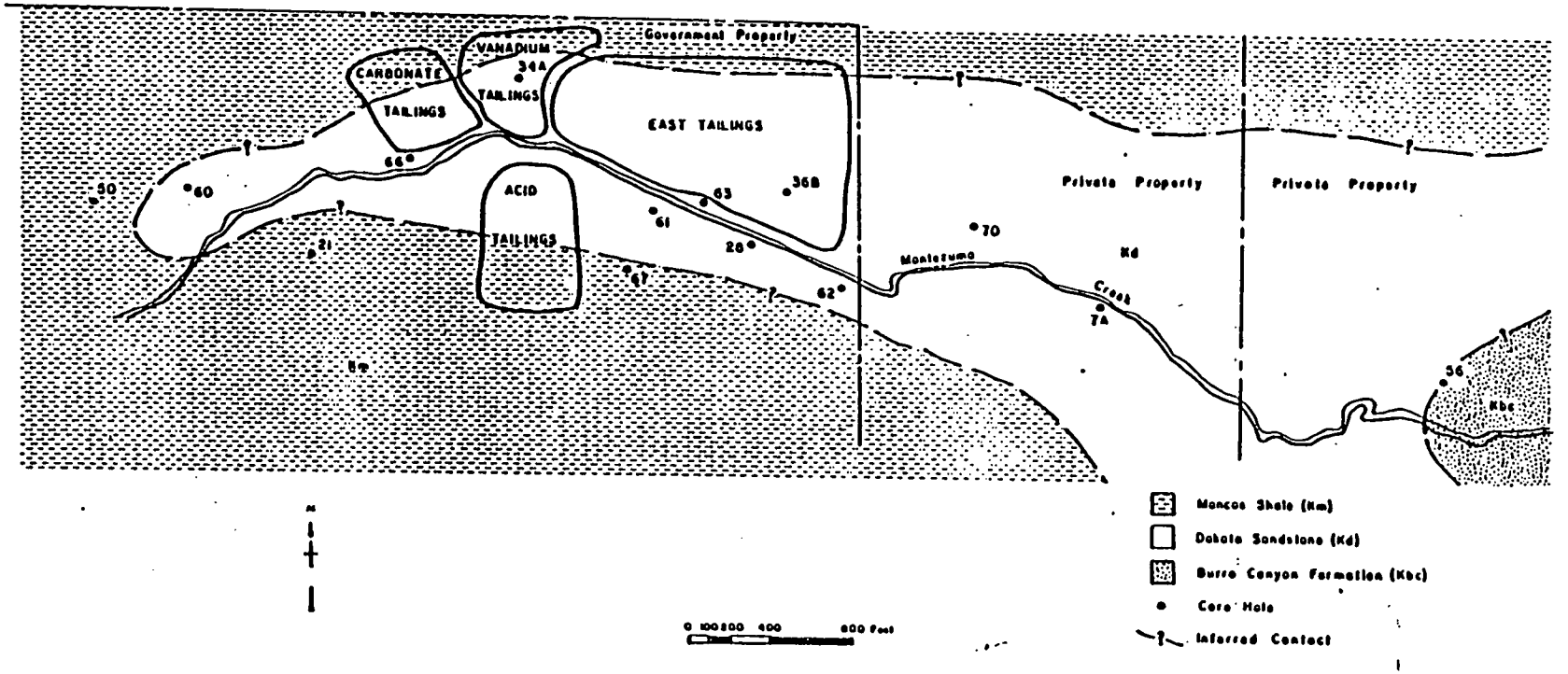


Figure 4-10. Map Showing Inferred Subcrop of Bedrock Formations

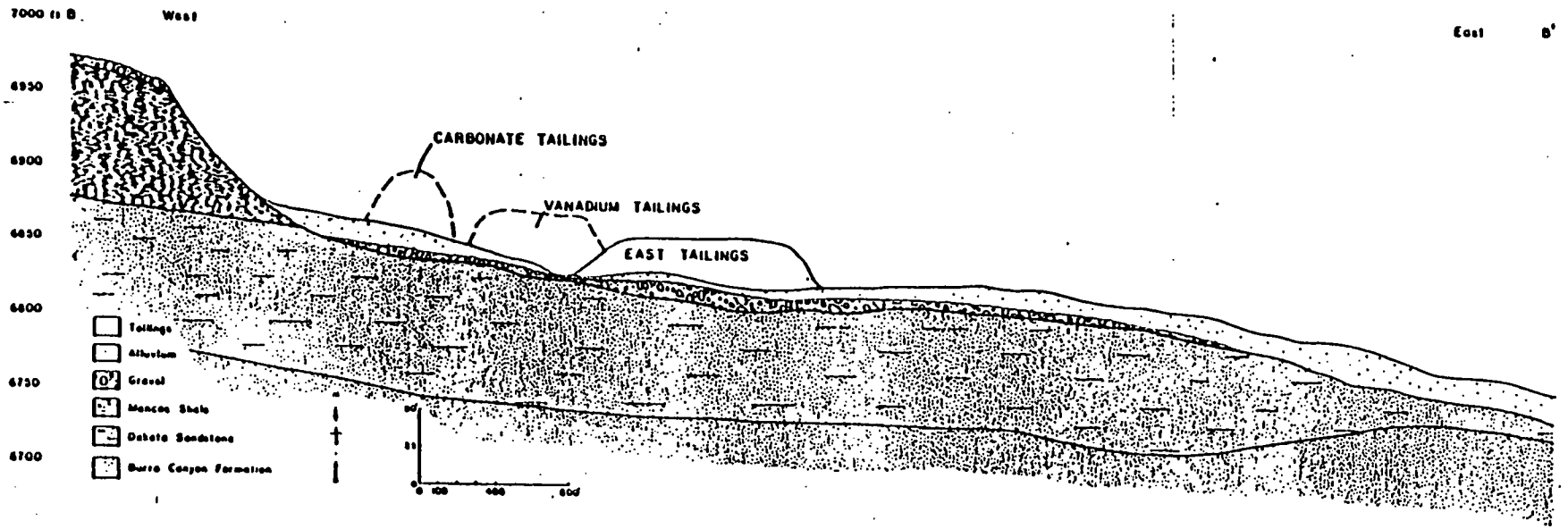


Figure 4-9. Generalized West-East Cross Section Through the Project Area (Dakota/Burro Canyon contact based on core data)

APPENDIX B

SUPPLEMENTAL SPECIFICATION FOR OBSERVATION WELL AND PIEZOMETER CONSTRUCTION

APPENDIX B
"SUPPLEMENTAL SPECIFICATION
FOR
OBSERVATION WELL AND PIEZOMETER CONSTRUCTION"

1.0 Well Construction Materials: This section specifies the well construction materials including well screen, riser pipe, well protector, sand pack, grout mix, and water. All materials used in construction shall be free of chemicals, paint, coatings, etc. that could leach out into the soil or groundwater.

1.1 Well Screen: Machine slotted PVC plastic well screen as manufactured by Triloc or approved equivalent shall be utilized unless directed otherwise by Geotech. The diameter of the well screen shall be as shown on the drawing. Well screen shall be furnished in five foot long sections or longer. A bottom plug shall be threaded and shall withstand all installation and well development pressures without becoming dislodged or damaged.

A. The slot (screen) size shall be .01 inch unless material characteristics dictate another size is necessary. In that case, the subcontractor shall determine the slot size and appropriate sand pack relative to the material.

B. The length of the screen shall be approximately 5-20 feet as shown on the drawings, unless formation characteristics dictate otherwise.

1.2 Riser Pipe: The Riser pipe shall consist of PVC pipe meeting ASTM D1785 with flush joint threads. Schedule 40 pipe shall be utilized. The interval between joints shall be five feet to twenty feet.

A. Threads to be in accordance with DCDMA standards or by independent tests the manufacturer shall demonstrate equivalency of the threaded joint to crushing.

B. All joints shall be Teflon taped, unless the specified pipe is equipped with O-Ring seals.

C. Glued joints of any type shall not be permitted.

D. Rivet joints shall not be permitted.

1.3 Casing: In the event that a well requires permanent steel casing, as decided in conference with Geotech and the Subcontractor.

A. The minimum inside diameter of steel casing shall be 1.75 times the outside diameter of the well screen and riser.

B. The minimum wall thickness of steel casing shall be 0.125 inches.

C. The ends of sections of casing shall be threaded or beveled for welding.

D. All casing to be new black pipe free of interior coatings.

1.4 Grout: Grout mix for use in well completion

A. Cement: Cement shall be Portland Cement Type I or Type II meeting ASTM C 150. The use of Hi Early Type III Cement is prohibited.

B. Water: Water shall be obtained from a potable source designated by Geotech.

C. Hydrated Lime: Hydrated Lime shall be ASTM C 207, Type S furnished in sacks. Hydrated lime shall not contain air entrainment additives.

D. Bentonite: Bentonite shall be powdered Sodium Bentonite furnished in sacks without additives.

E. Proportions: Cement shall be mixed with water in the proportions of five to six gallons of water per sack of cement. Hydrated lime may be substituted for cement up to ten percent by volume. Between two and four pounds of bentonite powder shall be added to the mix for each sack of cement used.

F. Mixing: The grout shall be thoroughly mixed with a paddle type mechanical mixer or by circulating the mix through a Moyno pump until all lumps are removed. Grout which is lumpy shall be rejected.

G. Grouting Lines: All hoses, tubes, pipes, water, swivels, drill rods, or other passageways through which the grout will be pumped shall have an inside diameter of at least 0.50 inches.

H. Grouting Procedure: Grout shall be injected under pressure to displace water and cuttings from the level immediately above the seal placed above the screened zone up to the top of the well hole. Grout injection shall be continued until clean grout flows out the top of the well hole.

I. Grouting Set Time: The well shall not be disturbed for at least 48 hours after grouting to allow the grout to set up and gain sufficient strength.

J. Samples Required: Two samples of grout shall be taken from each well completion, placed in plastic or glass jar (8 oz.), labeled and submitted to Geotech.

1.5 Sand Pack: Sand pack is the material placed in the annular space around the well screen.

A. Gradation: Sand pack shall be washed uniformly graded sand comprised of hard durable particles washed and screened with particle size at least four times the D15 size (15 percent of the

soil is finer than the D15) of the formation and no more than 4 times the D85 size of the formation soil. A 20-40 frac sand size is anticipated on this project.

B. Samples: One sample of sand pack for each observation well shall be submitted to Geotech.

1.6 Filter: Filter is the layer of material placed in the annular space between the sand pack and the bentonite seal.

A. Gradation: Filter shall be uniformly graded fine sand with a 100 percent by weight passing, the No. 30 sieve, and less than 2 percent by weight passing the 200 sieve.

B. Samples: Samples of filter shall be obtained, placed in plastic or glass jar (8 oz.), and submitted to Geotech.

1.7 Bentonite Pellets for Seals: Bentonite pellets are a commercial product consisting of compressed bentonite balls and sand, such as "Volclay Tablets".

A. Composition: The bentonite pellets shall be from a commercial source free of contaminants.

B. Size: The diameter of the pellets shall be less than one-half the width of the annular space into which they are to be placed (1/4" pellets are requested).

2.0 Well Screen and Riser Installation: This section covers the placement of the well screen, gravel pack, filter, seals, and annular grout in a well bore. The specifications relative to drilling and temporary stabilization of the well hole are covered in other sections. This section includes removal of the temporary casing and placement of the permanent well protector and sampling system. Figure 1 shows a diagram of a completed observation well.

A. Stable Well Hole: A stable well hole shall be constructed prior to attempting to install the well screen. If the well hole tends to cave or "blow out" the Subcontractor shall take steps to stabilize the well hole before attempting installation of the well screen. Well holes which are not plumb or are partially obstructed shall be corrected prior to attempting the installations described herein. Jetting or driving the well screen shall not be permitted. Well screen and riser pipes will be installed in the center of the borehole either by placing them through the hollow stem augers or by using centralizers.

B. Sequence: The sequence of operations described herein shall be adhered to unless a specific agreement is made with Geotech.

2.1 Assembly of Well Screen and Riser

A. Handling: The well screen including the bottom plug shall be clean and free of contamination immediately prior to assembly. The workmen shall take precautions to assure that grease, oil, or other contaminants do not contact the well screen. The workmen handling the well screen shall wear a new pair of cotton gloves while handling the well screen.

B. Teflon Taped Joints: Male threaded part of each joint shall be wrapped with Teflon Tape. Joints shall be tightened by hand; however, if necessary, clean pipe or chain wrenches may be utilized. The well screen and riser will be inserted into a well hole which is at least partially filled with water.

C. Ballasting the Riser: The well screen and riser shall be ballasted to counteract the tendency to float in the well hole by continuously filling the string of riser pipe with water from the approved source. Preferably water shall not be added, but the riser shall be slowly pushed into the water in the well hole with the aid of the hydraulic ram and held in place with chains as additional sections of riser are added to the string.

2.2 Setting the Well Screen: The well screen shall be lowered to the predetermined level and held in position by suspending the string of riser pipe or if the string tends to float, by manipulating the hydraulic ram. On deep holes where the weight of the string riser pipe is significantly more than the flotation force, care shall be taken to keep the riser pipe plumb. The riser shall extend above the ground at least three feet. The riser shall be trimmed to the proper length of 2.5 feet after the grout is in place. If the plumbness of the riser is especially critical or the well is extremely deep, a dummy should be lowered down the inside of the riser to verify that the riser is not kinked.

2.3 Placement of the Sand Pack

A. Volume of Sand Pack: The volume of sand pack required to fill the annular space between the well screen and the well hole shall be computed and carefully measured out. The sand pack shall typically extend five feet above the uppermost row of slots in the well screen or to five feet above the top of the granular zone being monitored, except where limited separation between aquifers occurs.

B. Centering the Well Screen: The well screen shall be centered in the well hole and temporary casing by pouring in approximately ten percent of the sand pack then placing a centering disk over the riser and tamping the disk into place with the seal tamper. The remaining sand pack shall be placed in increments with centering disks as required to assure that the well screen is centered. The level of each layer of gravel pack filter and seal shall be verified and recorded.

C. Withdrawal of the Temporary Casing: While holding the riser pipe with the drill rig, the temporary casing or hollow stem augers shall be carefully withdrawn such that the lower most point on the casing is exactly at the top of the gravel packed portion of the well hole. This may be accomplished in increments; however, after each increment, a centering disk and the seal tamper shall be inserted and slid down to ascertain that the gravel pack has not been raised during casing withdrawal operation. If necessary the gravel pack shall be tamped back into place.

2.4 Placement of the Filter: A volume of filter sand which will extend a distance of two feet up the annular space from the top of the sand pack shall be carefully measured out. The filter shall be poured into the annular space. If the level of water in the well hole extends above the sand pack, the seal tamper or a jetting tube shall be used to stir up the filter and prevent the segregation of the filter as it settles in the water in the well. The bottom of the temporary casing shall be raised to a level at least two but no more than five feet above the sand pack. Where conditions warrant, the filter may be eliminated. The Subcontractor shall evaluate the need for the filter considering the gradation of the sand pack, the hydraulic head and the potential for contamination of the sand pack with grout.

2.5 Placement of the Seal: A volume of bentonite pellets to create a seal two to five feet long shall be measured out and carefully poured into the annular space. If the bentonite seal is being constructed above the water level in the well hole, exactly five gallons of water shall be poured into the annular space. The seal tamper shall be lowered down and utilized to tamp the pellets into a cohesive mass of clay.

2.6 Grouting the Annular Space

A. Volume of Grout: The volume of grout required to completely fill the annular space between the sand filter and the ground surface shall be prepared in the proportions specified in Section 1.4. The volume shall include a quantity to compensate for losses.

B. Injection Procedures: The grout shall be injected via a tremie pipe who's opening is temporarily set immediately above the sand filter. The grout shall be pumped into the tremie pipe continuously until it flows out at the surface.

C. Casing Removal: The temporary casing shall be removed immediately and in advance of the time when the grout begins to set. Casing removal and injection may proceed concurrently provided the top of the column of grout is always at least twenty feet above the bottom of the casing and provided injection is not interrupted. If casing removal does not commence until grout injection is completed, then additional grout shall be periodically poured into the annular space so as to maintain a continuous column of grout up to the ground surface.

2.7 Well Protector: A well protector as shown in Figure 1 shall be set in the plastic grout. The well protector shall be positioned and maintained in a plumb position with temporary braces as required. A six inch clearance between the top of the riser and the well protector shall be maintained for the sampler. Grout which has overflowed the well hole shall be carefully removed so as to prevent the formation of horizontal projections (mushrooming) which may be subject to frost heave. A 1/4 inch diameter hole shall be drilled in the well protector 6 inches above the ground surface to permit water to drain out of the annular space. Coarse sand or pea gravel shall be placed in the annular space up to 6 inches above the hole to prevent insects from entering through the drilled hole. Three protective "drive" type fence posts shall be installed evenly spaced around the well at a 5 to 7 foot radius. Each post shall be painted for improved visibility.

3.0 Well Development and Acceptance: This section covers the purging and development of a newly constructed well and the measurement of the well characteristics. Also described is the acceptance criteria for a completed well.

3.1 Pumps for Well Development

A. General: All wells shall be pumped or evacuated using compressed air or nitrogen to produce representative formation water. This section describes the approved pumps and appurtenant works to be utilized in development of monitoring wells. All pumps and other devices used in well development shall be clean and free of oil, grease, solvents, or any other foreign contaminants.

B. Submersible Pumps: Submersible pumps shall include electric motor powered centrifugal or positive displacement type pumps which are operated under submergence. If a submersible pump is utilized for well development, it shall be of a type and capacity such that it can pump water from the well continuously for a period of at least five minutes without shutting off. Backpressure or other methods may be utilized to accomplish the desired rate of pumping. The pump shall be capable of being turned on and off instantaneously to create surges in the well. The pump shall be fitted with a backflow check valve.

C. Bladder Pumps: A bladder or diaphragm pump shall operate by compressed air cycling to inflate and deflate a diaphragm which creates a pumping action. Bladder pumps approved for well development shall be capable of pumping at least 3 gpm continuously when installed in the well.

D. Jet Pumps: A jet pump shall utilize the Venturi principle to create subatomospheric pressure to allow the pump to be utilized below a depth at which suction alone would not normally lift the water. Jet pumps approved for well development shall be capable of pumping at least 3 gpm continuously when installed in the well.

E. Bailers: Bailers shall not be utilized for well development except after an approved submersible bladder, jet or suction pump has been installed in the well or compressed air or bottled nitrogen has been used, and the rate of well recovery is so slow that these methods are ineffective. All discharged water must be controlled so as not to be a health risk to personnel.

F. Compressed Air: Compressed air supplied by an engine-driven compressor equipped with an approved oil trap may be utilized provided the source of compressed air is capable of evacuating 50 percent of the column of water from the well once every minute.

G. Bottled Nitrogen: Bottled nitrogen may be utilized provided an oil trap and regulator is employed and the system is capable of evacuating 50 percent of the column water from the well once every minute. OSHA standards must be followed.

3.2 Periods of Well Development

A. General: Well development shall be continued until representative formation water free of the effects of well construction is obtained. Representative formation water shall be assumed to have been obtained when pH, temperature, and conductivity readings are stable and the water is clean, and the minimum periods of development specified herein have been completed. Testing of pH, temperature, and conductivity shall be performed by the Subcontractor. All well development data shall be documented.

B. Period of Development: The minimum period of well development shall be in accordance with the following guidelines depending on the well development procedure selected.

1. Pumping with a Submersible Pump. Four hours.
2. Pumping with a Bladder Pump. Eight hours.
3. Pumping with a Jet Pump. Four hours.
4. Pumping with a Suction Pump. Four hours.
5. Compressed Air. Four hours cycling at two minute intervals.
6. Bottled Nitrogen: Four hours cycling at two minute intervals.
7. Bailers: Eight hours continuously alternating two men. This method to be used only if all other methods prove unfeasible.

3.3 Well Recovery Test: A well recovery test shall be performed immediately after development by the Subcontractor. Readings shall be taken at one minute intervals until the well has recovered to its static water level.

3.4 Well Acceptance: A well will be accepted by Geotech when development has been completed in accordance with these specifications, and the required documentation is furnished to Geotech. Once a well has been approved, the Subcontractor shall be relieved of any further responsibility for the performance, maintenance, or testing of that well.

4.0 Piezometer: Piezometer construction shall consist of the materials specified in this appendix. They are intended to be constructed in shallow dry holes and therefore do not contain all elements of the observation well. Refer to figure 2. In addition there is no need to grout or develop the piezometer. Install the 3 "drive" type fence posts but not the metal well protector. Hydrate the 2 foot thick bentonite seal.

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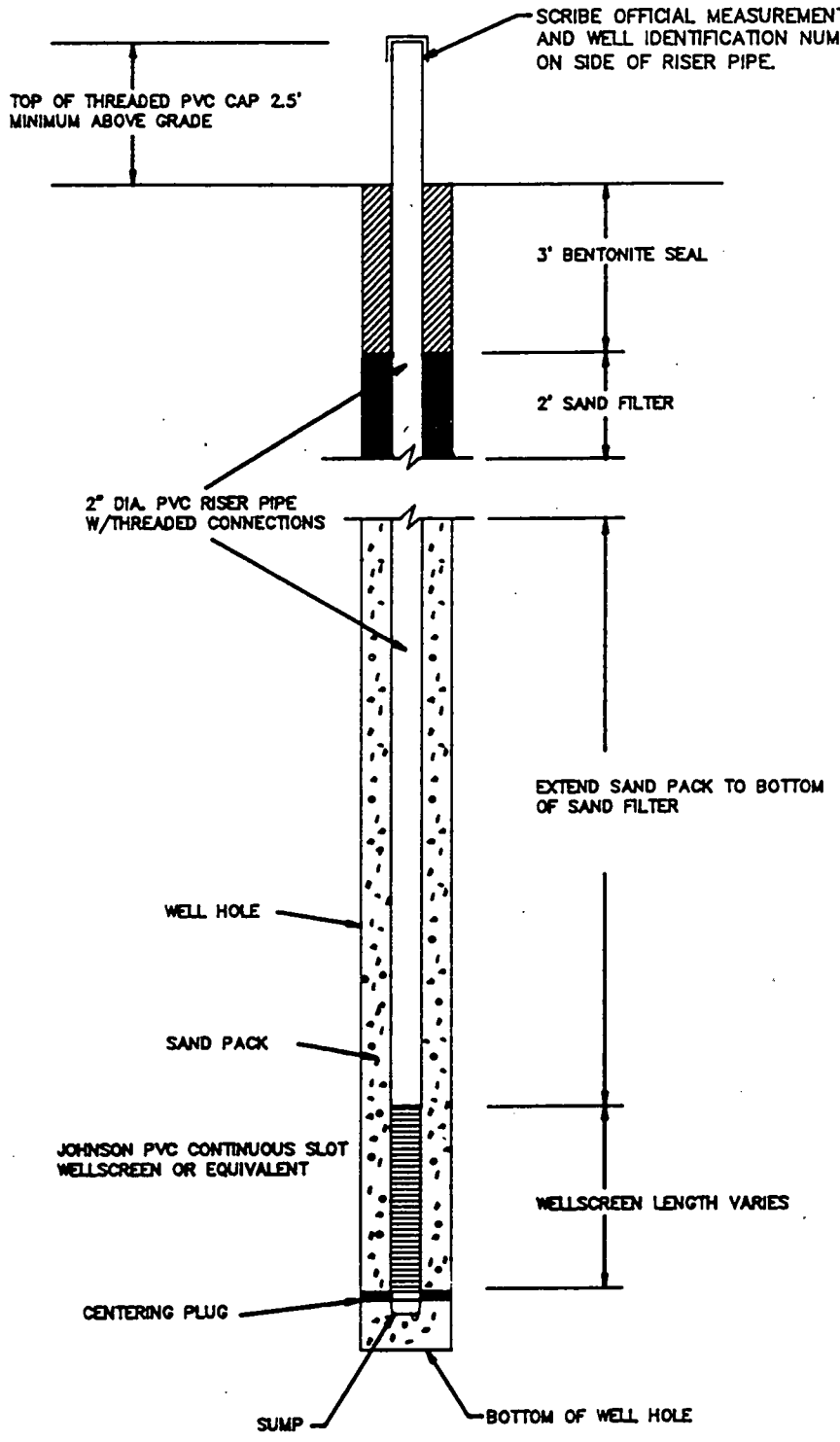

GEOTECH PIEZOMETER SPEC

FIGURE 2

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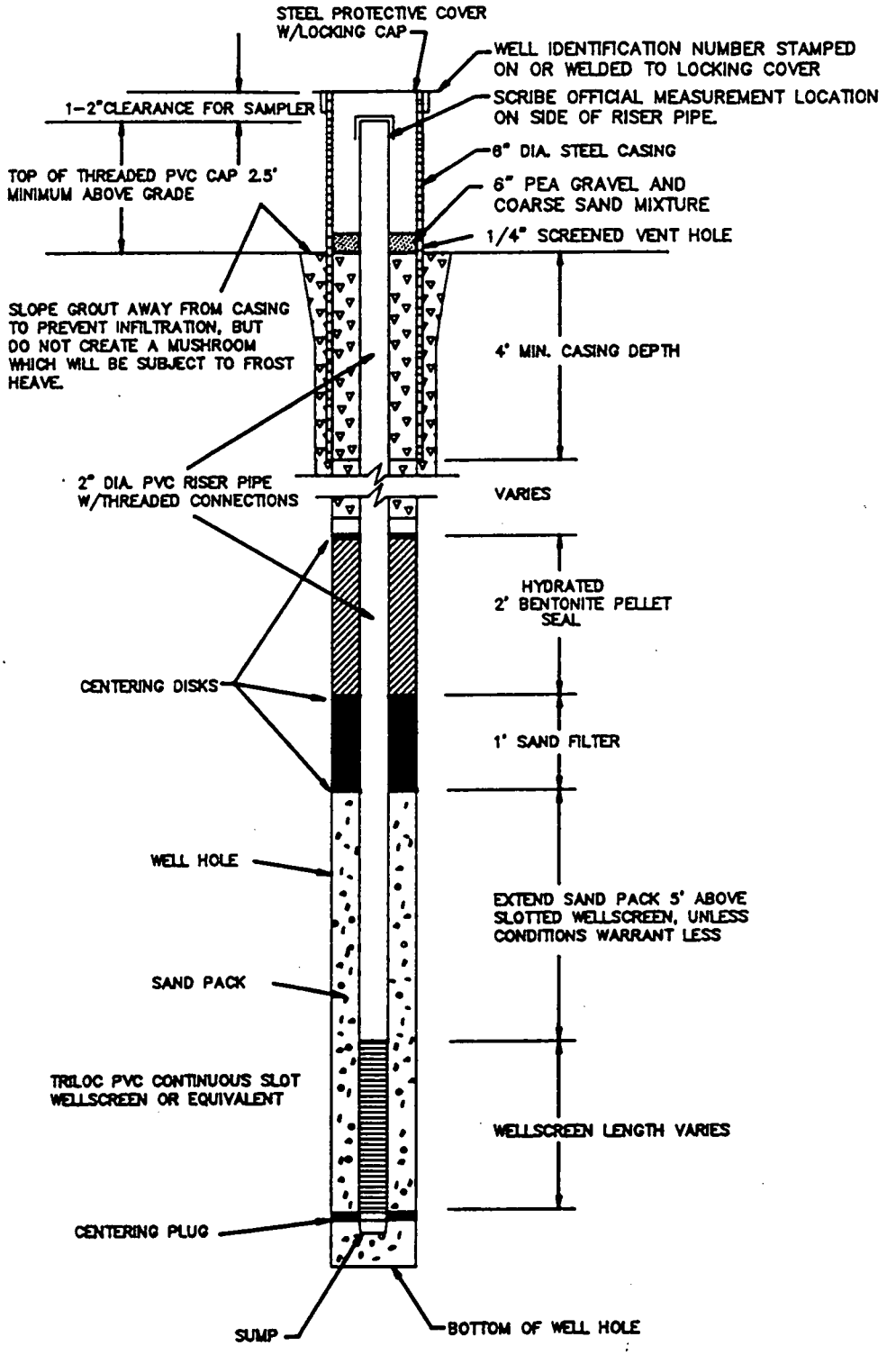

GEOTECH OBSERVATION WELL SPEC

FIGURE 2

APPENDIX C

STATE OF UTAH

ADMINISTRATIVE RULES FOR WATER WELL DRILLERS

STATE of UTAH

ADMINISTRATIVE RULES for WATER WELL DRILLERS

DIVISION of WATER RIGHTS

ROBERT L. MORGAN, P.E.
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Directing Engineer

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Water Well Program Director

STATE ARCHIVES NO. 8857

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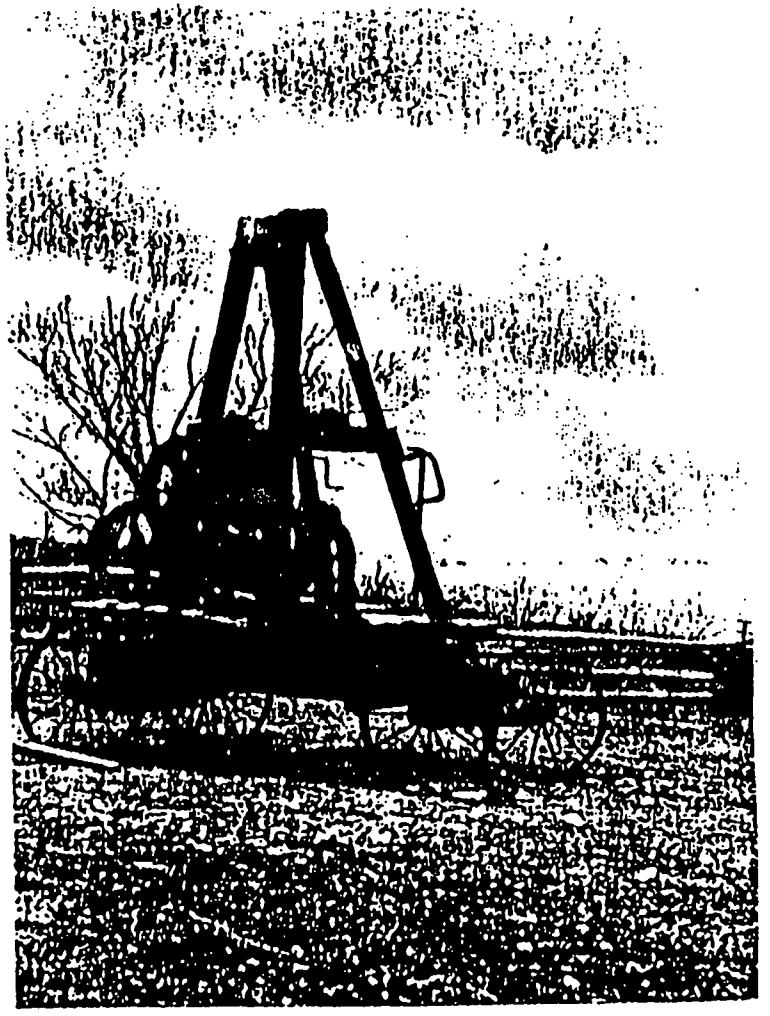


PART I

ADMINISTRATIVE RULES FOR WATER WELL DRILLERS

1 PURPOSE

These "Rules" are promulgated pursuant to Section 73-3-25 of the Utah Code Annotated 1953, as amended. The purpose of these rules is to assist in the orderly development of underground water, insure that minimum construction standards are achieved in the drilling and repairing of water wells, prevent pollution of aquifers within the state, prevent wasting of flowing wells, obtain accurate records of well drilling operations, and insure compliance with the state engineer's authority for appropriating water.

1.1 Construction standards outlined in this document are meant to serve as guidelines for minimum acceptable standards. In some cases more stringent standards would be called for if compliance with these standards would not result in a well which is free from pollution, or would be a source of subsurface leakage, or would result in contamination of the groundwater supply.

1.2 It is not intended that these rules govern the drilling of geothermal wells. Anyone contemplating drilling of geothermal wells is subject to Title 73 Chapter 22 of the Utah Code Annotated 1953 and the rules promulgated pursuant to that section. The State Engineer's Office can be contacted for information regarding drilling of geothermal wells.

1.3 It is not intended that the following rules govern the drilling of temporary exploratory holes that are drilled to obtain information on the subsurface strata on which an embankment or foundation is to be placed, or an area proposed to be used as a potential source of material for construction.

1.4 In order to provide for protection of the water resources of the state and obtain valuable information on the aquifers of the state, Section 73-3-22 Utah Code Annotated 1953 and the "Rules" have been amended to include the drilling of water monitoring wells.

1.5 Wells constructed to monitor man-made structures, house instrumentation to monitor structural performance, or dissipate hydraulic pressures on structures are exempt from the following rules, provided that the wells do not interfere with established acquifers, or their primary purpose is not for monitoring water quality.

1.6 Public water supply wells are subject to additional requirements established by the Utah Safe Drinking Water Committee, pursuant to their authority under Title 26 Chapter 12 of the Utah Code Annotated 1953. The Utah Bureau of Drinking Water/Sanitation may be contacted for additional information regarding public water supply wells. Generally, plans and specifications for a public supply well must be reviewed and approved by the Bureau before the well is drilled.

2 DEFINITIONS

2.1 ABANDONED WELL--a well whose purpose and use have been permanently discontinued or a well that is in such a state of disrepair that its purpose cannot be reasonably achieved.

2.2 ANNULAR SPACE--the space between the inner well casing and the outer well casing or borehole.

2.3 AQUIFER--a porous underground formation yielding usable amounts of water.

2.4 ARTESIAN AQUIFER--a water-bearing formation which contains underground water under sufficient pressure to rise above the zone of saturation.

2.5 ARTESIAN WELL--a well where the water level rises appreciably above the zone of saturation.

2.6 BENTONITE--a highly plastic, highly absorbent, colloidal clay composed largely of mineral montmorillonite.

2.7 CASING--a tubular retaining structure that is installed in the borehole to maintain the well opening.

2.8 CONSOLIDATED FORMATION--bedrock consisting of sedimentary, igneous, or metamorphic rock. A consolidated impermeable formation shall have sufficient thickness to form a geologic barrier in the vicinity of the well in order to be incorporated in the surface seal of a well.

2.9 DRAWDOWN--the difference in elevation between the static and pumping water levels.

2.10 GRAVEL-PACKED WELL--a well in which filter material is placed in the annular space to increase the effective diameter of the well and to prevent fine-grained sediments from entering the well.

2.11 GROUT--a fluid mixture of portland cement and water of a consistency that can be forced through a pipe and placed as required. Various additives, such as sand, bentonite, and hydrated lime, may be added.

2.12 MONITOR WELL--A "well" (as defined in 2.24) which is constructed for the purpose of determining water levels and/or monitoring chemical, bacteriological or other physical properties of groundwater or vadose zone water.

2.13 NEAT CEMENT GROUT--cement conforming to ASTM Standard C150, with no more than six gallons of water per sack of cement.

2.14 OPERATOR--a drilling-machine operator is an individual who is employed by a driller holding a current Utah Well Driller's license for the purpose of constructing water wells with equipment owned by the licensee.

2.15 PUBLIC SUPPLY WELL--a well, either publicly or privately owned, providing water for human consumption and other domestic uses which has at least 15 service connections or regularly serves an average of at least 25 individuals daily for at least 60 days out of the year.

2.16 PUDDLING CLAY--a mixture of bentonite, other expansive clays, or fine-grained material and water, in a ratio of not less than 7 pounds of bentonite or expansive clay per gallon of water.

2.17 STATE ENGINEER--state engineer means the Director of the Utah Division of Water Rights or any employee of the Division of Water Rights designated by the state engineer to act in administering these rules.

2.18 STATIC LEVEL--stabilized water level in a nonpumped well beyond the area of influence of any pumping well.

2.19 TEST WELL--a well completed to obtain information on groundwater quality, quantity, and geologic conditions.

2.20 TREMIE PIPE--a device that carries materials to a designated depth in a drill hole.

2.21 UNCONSOLIDATED FORMATION--loose, soft, incoherent rock-material composed of sedimentary, igneous, or metamorphic rock which includes sand, gravel, and mixtures of sand and gravel.

2.22 VADOSE ZONE--the zone containing water under less than atmospheric pressure, including soil water, intermediate vadose water and capillary water. The zone extends from land surface to the water table.

2.23 VALID AUTHORIZATION TO DRILL--shall consist of any of the following:

a) An approved application to appropriate.
b) An approved "rush letter".
c) An approved permanent change application.
d) An approved exchange application.
e) An approved temporary change application.
f) An approved application to renovate or replace.
g) An approved "test well letter".
h) An approved "monitor well letter".
i) Any letter or document from the state engineer directing or authorizing work to be done on a well.

Most of the above expire after predetermined periods of time. Items a) through f), inclusive, allow the applicant to contract with a well driller to drill or renovate exactly one well at each point of diversion listed on the approved form. When the work contemplated is completed or abandoned, the permission to drill terminates. An approved test well or monitor well letter is a special case permitting exploratory drilling but allowing only enough water to be diverted from the approved points to determine the characteristics of the groundwater source.

2.24 WELL--a horizontal or vertical excavation or opening into the ground made by digging, boring, drilling, jetting, or driving or any other artificial method for utilizing or monitoring underground waters.

2.25 WELL DRILLER--any person duly licensed by the state engineer that constructs a well for compensation or otherwise.

2.26 WELL DRILLING--the act of constructing, repairing, or deepening a well, including all incidental work.

3 WELL DRILLER'S LICENSES

3.1 GENERAL. State law requires every person that constructs a well in Utah to obtain an annual well driller's license from the state engineer and to file with him a bond in the penal sum of $5000 (Payable to the Office of the State Engineer) conditioned upon proper compliance with the law and rules for well drillers. Applications for well driller's licenses shall be made on forms furnished by the state engineer. All licenses expire on the 31st day of December following their issuance and are not transferable.

3.2 APPLICATION FOR LICENSE. Before a Utah well driller's license will be issued, the applicant must do all of the following:

3.2.1 Make application to the state engineer on forms provided for that purpose, including documentation of prior well drilling experience.

3.2.2 Pay an application fee of $45.00. (Annual renewal fee thereafter is $22.50.)

3.2.3 File a bond in the penal sum of $5000 with the state engineer, conditioned upon compliance with the law and these rules, and effective for the calendar year in which the license is to be issued.

3.2.4 Obtain a score of at least 70% on the written or oral examination administered by the state engineer to test the applicant's knowledge of:

a) Utah Water Law as it pertains to underground water;
b) Land description by section, township, and range;
c) Geologic formations and proper names used in describing underground material types;
d) Groundwater geology and the occurrence and movement of groundwater;
e) The rules for water well drillers;
f) The minimum standards for well construction;
g) The proper construction methods and techniques for the various types of well drilling rigs, and equipment the applicant proposes to use to construct wells in the state.

3.2.5 If the applicant fails to obtain the minimum passing score on the written/oral examination, he may make re-application to the state engineer for a license and re-examination 90 days from the date of the previous application.

3.2.6 Have reached the age of majority.

3.2.7 The state engineer may issue a restricted or conditional license to an applicant based on his drilling performance and compliance with established rules and construction standards for a time period prescribed by the state engineer.

3.3 OPERATOR REGISTRATION.

3.3.1 An operator may become registered with the State Engineer's Office in order to substantiate claims of experience when applying for his own well driller's license at some future date.

3.3.2 An operator may become registered with the State Engineer's Office by doing all of the following:

3.3.2.1 Filing an application with the state engineer on forms provided for that purpose.

3.3.2.2 Obtaining a score of at least 70% on a written and/or oral examination to test the applicant's knowledge of:

a) Land description by section, township, and range;
b) Geologic material and proper names used in describing underground material types;
c) The rules for water well driller's; and
d) The minimum standards for well construction.

3.3.2.3 An operator must be under the supervision of a well driller holding a current Utah Well Driller's license. Such supervisor need not be continually present at the drilling site but must be available to provide supervision as the work progresses.

3.4 DRILLING WITHOUT A LICENSE. Any person found to be drilling a well without a valid well driller's license will be ordered to cease and desist by the state engineer. Such order may be made verbally but must be followed by a written order. The order may be posted at an unattended well site. A person found drilling without a license will be prosecuted under Title 73-3-26, Utah Code Annotated 1953. (See Section 5.8)

4 GENERAL REQUIREMENTS

4.1 All drillers, as a condition of the continuation of their license to drill wells in Utah shall do all of the following:

4.1.1 Prior to commencing any work on a well, file written notice of that intention on a card furnished by the state engineer. The notice shall include the following:

a) The date on which it is proposed to commence work;
b) The nature of the work to be performed;
c) The owner's name for whom the well is to be drilled, or renovated.
d) The area code number, application number, change application number, exchange number, or underground water claim number on file in the State Engineer's Office shall be indicated. If the well is to be drilled under an approved test well or monitor well letter, the approval date and approval number.
e) The diameter of casing to be used;

f) The location of the well by section, township and range;
g) The card shall be signed by the licensed well driller.

When authorization is given to drill wells at more than one point of diversion, notice shall be given for each location to be drilled.

4.1.2 Comply with the minimum well construction standards as adopted by the state engineer and hereinafter included.

4.1.3 Have a qualified operator at the well site at all times during the actual work of construction, development or abandonment of the well. All persons operating under a well driller's license shall be employees of the well driller and use the licensed well driller's equipment. All wells, when unattended during construction or renovation, shall be securely covered.

4.1.4 Not allow any person to engage in the well drilling business under the authorization of their license without prior review and written consent of the state engineer.

4.2 The well driller's license number must be prominently displayed on every well drilling rig they operate in the state.

4.3 Within thirty (30) days of the completion or abandonment of any well, the driller shall file a report with the state engineer giving the data relating to that well. The report shall be made on forms furnished by the state engineer and shall contain such information as he may require, including but not limited to the following:

a) The name and post-office address of the driller;
b) The name and post-office address of the well owner;
c) The area code number of the valid authorization to drill or in the case of a well drilled under a test well or monitor well letter, the date of the letter and designated approval number;
d) The location of the well;
e) The size and type of casing, perforations, packers, seals, etc.;
f) The depth of the well;
g) The log of the well;
h) The beginning and completion dates for construction, renovation or abandonment of the well;
i) The temperature and quantity of water issuing, drawn, or pumped therefrom;
j) The location of all water-bearing strata.
k) The static water level in the well at the time of completion.
for the purposes of these rules, a well will be considered completed or abandoned when the well driller removes his drilling rig from the well site, unless the well driller provides written notice to the state engineer that he plans to continue work at some later date.

4.4 The well driller shall have the required penal bond continually in effect during the term of the well driller's license.

4.5 The well driller shall make certain that a valid authorization or approval exists to drill before beginning drilling. The authorizations to drill listed in Section 2.23, allow the applicant to contract with a well driller to drill, or renovate exactly one well at each location listed on the approved form. When the work is completed or abandoned, the permission to drill is terminated. An approved test well or monitor well letter is a special case permitting exploratory drilling but allowing only enough water to be diverted to determine the characteristics of the ground water source.

5 PENALTIES

5.1 The state engineer, upon investigation and after a hearing, on at least ten days' notice given to the licensee by registered mail, may revoke or suspend any well driller's license either permanently or for a fixed period determined by the state engineer, if he finds that the well driller has done any of the following:

a) Intentionally made a material misstatement of facts in his application for a license;
b) Intentionally made a material misstatement of fact in a well driller's report;
c) Been found to be incompetent as a well driller;
d) Willfully violated any of the prescribed rules;
e) Failed to submit notice of intention to drill in accordance with these rules;
f) Failed to submit a report of well driller, completed in accordance with these rules.
g) Allowed any person to operate under their license without prior written approval by the state engineer.

5.2 If the state engineer determines, following an investigation and a hearing upon at least ten days notice to the licensee, by registered mail, that the licensee has failed to comply with the rules, the state engineer may exact the bond and deposit the money as a non-lapsing dedicated credit.

5.3 The state engineer may expend the funds to investigate or correct any deficiencies which could adversely affect the public interest resulting from non-compliance with the rules by any well driller.

5.4 After the period set by the state engineer under a revocation or suspension has expired, a well driller may make application for a new license.

5.5 A well driller who has had his license revoked or suspended will be prohibited from operating well drilling equipment during the revocation or suspension period set by the state engineer.

5.6 The state engineer may, upon investigation and after a hearing, refuse to issue a license to an applicant if it appears:

a) That he has not had sufficient training or experience to qualify him as a competent well driller or;
b) That he has intentionally violated the Utah Statutes governing well drillers or these rules relating to well drilling or;
c) That he has intentionally made a material misstatement of fact in an

application for a license, in a well driller's report, or in any other document filed in the State Engineer's Office.

5.7 Lack of knowledge of the law or the rules relating to well drilling shall not constitute an excuse for violation thereof.

5.8 Title 73 Chapter 3 Section 26 of the Utah Code Annotated 1953 provides that:
(1) Any person that does any of the following is guilty of a Class B misdemeanor:
(a) Constructs a well without first obtaining a license as required by this chapter;
(b) Advertises to be a well driller without first obtaining a license as required by this chapter;
(c) Constructs a well after suspension revocation or expiration of his license;
(d) Constructs a well in violation of the rules promulgated under Subsection 73-3-25 (1).
(2) Each day of failure to comply with the provisions of this section constitutes a separate offense.

6 RENEWAL OF WELL DRILLER'S LICENSE AND QUALIFICATION OF OPERATORS

6.1 ACTIVE LICENSES.

6.1.1 All well driller's licenses expire on December 31 of the year in which they are issued. Renewal of license will be made upon payment of a $22.50 fee, written application to the state engineer, submission of proof of $5000 penal bond for the next year, and proper submission of all start cards and well logs for the current year. Renewal of an operator's registration will be made upon written application to the state engineer.

6.1.2 Having met all requirements as set forth in 6.1.1 on or before December 31, the licensee shall be authorized to operate as a well driller until his new license is issued.

6.1.3 License renewal applications not meeting the requirements of section 6.1.1 and/or received after their December 31 expiration date will be assessed an additional $22.50 administrative late fee before the state engineer will consider license renewal.

6.2 RENEWAL OF INACTIVE LICENSES.

6.2.1 Drillers who have held an active license within the previous 24 months shall make application under provisions of Section 6.1.

6.2.2 Drillers who have not held an active license within the previous 24 months shall make application under the provisions of Section 3.2.

Part II

MINIMUM CONSTRUCTION STANDARDS

7 GENERAL

7.1 GENERAL. The failure of a water well driller to abide by these minimum standards can result in any of the following:
(1) the revocation or suspension of his well driller's license.
(2) a finding that he is guilty of a misdemeanor.
(3) the exacting of his bond by the state engineer. In some locations, the compliance with the following minimum standards will not result in a well being free from pollution or from being a source of subsurface leakage, waste, or contamination of the groundwater supply. Since it is impractical to attempt to prepare standards for every conceivable situation, the well driller shall use his judgement to construct wells under more stringent standards when such precautions are to protect the groundwater supply and those using the well in question.

7.2 WELL CASING. It shall be the sole responsibility of the well driller to determine the suitability of any type of well casing for the particular well he is constructing, in accordance with these minimum requirements. The well casing shall extend a minimum of 18 inches above ground level and the natural ground surface should slope away from the casing.

7.2.1 Steel Casing. All steel casing intalled in Utah shall be in new or like-new condition, being free from pits or breaks, and shall meet the minimum specifications listed in Table 1.

TABLE -1-

MINIMUM WALL THICKNESSES FOR STEEL WELL CASING

Nominal Casing Diameter (In)	DEPTH 0 to 200 (Ft)	200 to 300 (Ft)	300 to 400 (Ft)	400 to 600 (Ft)	600 to 800 (Ft)	800 to 1000 (Ft)	1000 to 1500 (Ft)	1500 to 2000 (Ft)
2	.154	.154	.154	.154	.154	.154	....	....
3	.216	.216	.216	.216	.216	.216	....	....
4	.237	.237	.237	.237	.237	.237	.237	.237
5	.250	.250	.250	.250	.250	.250	.250	.250
6	.250	.250	.250	.250	.250	.250	.250	.250
8	.250	.250	.250	.250	.250	.250	.250	.250
10	.250	.250	.250	.250	.250	.250	.313	.313
12	.250	.250	.250	.250	.250	.250	.313	.313
14	.250	.250	.250	.250	.313	.313	.313	.313
16	.250	.250	.313	.313	.313	.313	.375	.375
18	.250	.313	.313	.313	.375	.375	.375	.438
20	.250	.313	.313	.313	.375	.375	.375	.438
22	.313	.313	.313	.375	.375	.375	.375	.438
24	.313	.313	.375	.375	.375	.438	....	....
30	.313	.375	.375	.438	.438	.500	....	....

7.2.2 Plastic Casing. PVC, SR, ABS, etc. casing may be installed in Utah upon obtaining permission of the well owner. Plastic well casing shall be manufactured and installed to conform with ANSI/ASTM F 480-81, SDR 21 or the most recent revision thereof. The casing is normally marked "WELL CASING" and with the ANSI/ASTM designation "f 480-81, SDR-21". All plastic casing for use in potable water supplies shall be manufactured to be acceptable to the National Sanitation Foundation Testing Laboratory, Inc. Other types of plastic casings may be installed upon manufacturers certification that such casing meets or exceeds the above described ASTM/SDR specification. Minimum specifications are given in Table 2.

TABLE -2-

WALL THICKNESS FOR THERMOPLASTIC WATER WELL CASING PIPE

Nominal Casing Diameter (In.)	Minimum Thickness (In.)	SDR
2	0.133	21
2.5	0.137	21
3	0.167	21
3.5	0.190	21
4	0.214	21
5	0.265	21
6	0.316	21
8	0.410	21
10	0.511	21
12	0.606	21
14	0.667	21
16	0.762	21

ASTM Specification, F480-81

7.3 CASING JOINTS. All well casing joints shall be made water tight. In instances in which a reduction in casing diameter is made, there shall be enough overlap of the casings to prevent misalignment and to insure the making of an adequate seal in the annular space between casings to prevent the movement of unstable sediment into the well, in addition to preventing the degradation of the water supply by the migration of inferior quality water through the annular space between the two casings.

7.3.1 Steel Casing. All steel casing shall be screw-coupled or welded. If the joints are welded, the weld shall be at least as thick as the wall thickness of the casing and shall consist of at least two beads for the full circumference of the joint.

7.3.2 Plastic Casing. All plastic well casing shall be either screw coupled or chemically welded as per ANSI/ASTM F480-81 standards. Metal screws driven into casing joints shall not be long enough to penetrate the inside surface of the casing. Metal screws should be used only when cold (below 50 deg. F) temperatures retard the normal setting of the cement.

7.4 MINERALIZED OR POLLUTED WATER. Whenever a water bearing stratum that contains nonpotable mineralized or polluted water is encountered, the stratum shall be adequately sealed off so that contamination of the overlying or underlying groundwater zones will not occur.

7.5 EXPLOSIVES. Explosives used in well construction shall not be detonated within the section of casing designed or expected to serve as the surface seal of the completed well, whether or not the surface seal has been placed.

7.6 CHLORINATION OF WATER. No contaminated water shall be placed in a well during construction. Water should be obtained from a chlorinated municipal system. Where this is not possible, the water must be treated to give 100 ppm free chlorine residual. Table 3 gives the amount of bleach or dry powder required per 100 gallons of water to mix a 100 ppm solution.

TABLE -3-

AMOUNT OF HYPERCHLORITE FOR EACH 100 FEET OF WATER STANDING IN WELL (100 ppm soluton)

Well Diameter (inches)	5.25% Solution (cups)*	25% Powder (ounces)	70% Powder (ounces)**
2	0.50	1.00	0.50
4	2.25	3.50	1.50
6	5.00	8.00	3.00
8	8.50	14.50	5.50
10	13.00	22.50	8.50
12	19.00	32.50	12.00
14	26.00	44.50	16.50
16	34.00	58.00	26.00
20	53.00	90.50	33.00
100 gal	3.50	5.50	2.00

* Common Laundry Bleach

** HTH - High Test hypochlorite

7.7 ACCESS PORT. Every well shall be equipped with a usable access port so that the position of the water level, or pressure head, in the well can be measured at all times.

7.8 PROTECTION OF AQUIFER. The well driller shall take due care to protect the producing aquifer from clogging or contamination. He shall make every effort to remove all substances and materials introduced into the aquifer or aquifers during well construction. "Substances and materials" shall mean all drilling fluids, filter cake, lost circulation materials, and any other organic or inorganic substances added to the drilling fluid that may seal or clog the aquifer or provide a medium for the growth of organisms. This is especially important in the construction of wells designed to be used as a public drinking water supply.

7.9 COMPLETION OR ABANDONMENT. A licensed driller shall not remove his drill rig from a well site unless the well is completed or abandoned. Completion of a well shall include all surface seals, gravel packs or curbs required. Abandonment of a well shall be in compliance with Section 12.

8 DRILLED WELLS

Drilled wells shall be drilled in compliance with the following standards. Bored, jetted, or driven wells shall be considered to be drilled wells for purposes of these rules.

8.1 WELL CASING. All well casing installed shall meet the minimum standards given in Sections 7.2.1 and 7.2.2. Plastic casing is not recommended for use in wells drilled by the Cable Tool method.

8.2 SEALING OF CASING. All drilled wells shall have a surface seal installed in accordance with the provisions of Table 4. Neat cement grout, sand cement grout, bentonite or expansive clays may be used in the surface seal. All grout placed deeper than 30 feet or under water shall be placed by tremie line, pumping, or pressure. Portland Cement grouts must be allowed to cure a minimum of 72 hours for Type I cement or 36 hours for Type III cement before construction or pump testing may be resumed.

TABLE -4-

CASING GROUTING TABLE

Overburden	Minimum Grouting Depth	Minimum Non-Perforated Casing Depth
Unconsolidated, Permeable Formations	18 Feet to Surface	Below Lowest Pumping Level
Clay or Stratified Deposits of Sand, Gravel, and Clay	18 Feet to Surface and Driven 5 Feet into an Impervious Clay Layer	Top of the Uppermost Producing Zone
Consolidated Rock	18 Feet to Surface and Grouted 5 Feet into a Rock Formation	18 Feet or 5 Feet into the Rock Formation

8.2.1 Casing. Non-perforated casing shall be installed to the minimum depths given in Table 4. A perforated liner, well screen, or smaller casing may be installed below the well casing, if necessary, to complete the well. The annular space between the two casings shall be sealed water-tight with grout, expansive clay, or a mechanical packer. Figures 1, 2, 3, and 4 illustrate typical well completions in the various formations listed in Table 4.

8.3 GRAVEL PACKED WELLS.

8.3.1 Oversize Hole. The diameter of the borehole shall be at least four inches larger than the diameter of the casing to be installed to allow for proper placement of the gravel/filter pack and adequate clearance for tremie pipe for grout/surface seal installations (Figure 4).

8.3.2 Filter Material. The filter material shall consist of clean, well rounded grains that are smooth and uniform. The filter material should not contain more than 2% by weight of thin, flat, or elongated pieces and should not contain organic impurities or contaminants of any kind. In order to assure that no contamination is introduced into the well, the gravel pack should be washed with a 100 ppm solution of chlorinated water (Table 3) or dry chlorine should be mixed with the gravel pack at the surface before it is introduced into the well.

8.3.3 Placement of Filter Material. All filter material shall be placed using a method that through common usage has been shown to minimize 1) bridging of the material between the borehole and the casing, and 2) excessive segregation of the material after it has been introduced into the annulus and before it settles into place..

8.3.4 No Surface Casing Used. If no permanent surface casing is installed, a cement grout or puddling clay seal shall be installed to at least 5 feet into a clay layer or other tight formation overlying the producing zone. The well seal shall extend down at least 18 feet from the land surface.

8.3.5 Surface Casing Used. If permanent surface casing is installed, it shall be unperforated and installed in accordance with Table 4. After the gravel pack has been installed, the inner casing may be sealed by either welding a water-tight steel cap between the two casings at land surface or filling the annular space between the two casings with cement grout, bentonite, or puddling clay from 18 feet to the surface.

8.4 SPECIAL ADDITIONAL STANDARDS FOR ARTESIAN WELLS.

8.4.1 Sealing of Casing. Unperforated well casing shall extend into the confining stratum overlying the artesian zone, and shall be adequately sealed into the confining stratum so as to prevent both surface and subsurface leakage from the artesian zone.

8.4.2 Elimination of Leakage. If leaks occur around the well casing or adjacent to the well, the well shall be completed with the seals, packers, or casing necessary to eliminate the leakage.

8.4.3 Control Valves. If a well flows, it shall be equipped with a suitable control valve. The control valve, must be available for inspection at all times.

9 DUG WELLS

9.1 SURFACE CURBING.

9.1.1 All dug wells greater than 12 feet in depth shall be constructed with a water-tight surface curbing extending to a depth of 18 feet, or to within 3 feet of the bottom of the well in the case of wells ranging from 12 to 21 feet in depth. The surface curbing shall be of concrete, concrete tile, or steel. If concrete is used, the wall thickness shall not be less than 6 inches. In the case of the buried slab type of well, well casing meeting the minimum specifications given in Sections 7.2.1 and 7.2.2 must be installed (figure 5).

9.1.2 If precast concrete tile or steel is used for the surface curbing, the well diameter to the bottom of the surface curbing shall be 8 inches greater than the outside diameter of the tile or steel and the annular space shall be filled with concrete.

9.1.3 Well Seal. In a buried-slab type of well, the slab shall be at least 18 feet below land surface. The slab shall be sealed with cement grout and the well bore backfilled with puddled clay (figure 5).

10 DEEPENING OR RENOVATION OF WELLS

10.1 SEALING OF CASING. If in the repair of a drilled well, the old casing is withdrawn, the well shall be recased in accordance with the rules set forth in Section 8.

10.2 INNER CASING. If an inner casing is installed to prevent leakage of undesirable water into a well, the space between the two well casings shall be completely sealed using packers, casing swedging, pressure grouting, etc., so as to prevent the movement of water between the casings.

10.3 OUTER CASING. If the "over-drive" method is used to eliminate leakage from the existing well, the casing driven over the well shall meet the minimum specifications listed in Section 7.2.1.

10.4 ARTESIAN WELL. If upon deepening an existing well, an artesian zone is encountered, the well shall be cased and completed as set forth in Section 8.

10.5 DRILLING IN A DUG WELL. A drilled well may be constructed through an existing dug well provided that:

10.5.1 An unperforated section of well casing extends from a depth of at least 10 feet below the bottom of the dug well and at least 20 feet below land surface to above the maximum water surface in the dug well, and

10.5.2 A 2 foot thick seal of concrete or puddled clay is placed in the bottom of the dug well so as to prevent the direct movement of water from the dug well into the drilled well, and

10.5.3 The drilled well shall be pumped or bailed to determine whether the seal described above is adequate to prevent movement of water from the dug well into the drilled well. If the seal leaks, additional sealing and testing shall be performed until a water tight seal is obtained.

11 SPECIAL STANDARDS FOR PARTICULAR WELLS

11.1 UNUSUAL CONDITIONS. If unusual conditions occur at a well site and compliance with these rules and standards will not result in a satisfactory well or protection to the water supply, a licensed water well driller may request that special standards be prescribed for a particular well. The request for special standards shall be in writing and shall set forth the location of the well, the name of the owner, the unusual conditions existing at the well site, the reasons that compliance to the rules and minimum standards will not result in a satisfactory well, and the proposed standards that the licensed water well driller believes will be more adequate for this particular well. If the state engineer finds that the proposed changes are in the best interest of the public, he will approve the proposed changes by assigning special standards for the particular well under consideration.

11.2 SPECIAL STANDARDS. If in the course of investigating the groundwater resources of Utah, the state engineer finds that special standards are required for the development of groundwater from any particular groundwater reservoir or area, special standards for the construction and maintenance of wells may be prescribed.

11.2.1 Special Water Well Casing Standards for the 71, 73, 75, and 77 Drainage Areas.

11.2.1.1 During the course of his investigations of groundwater in the previously mentioned drainages, the state engineer has found that a variance in water well casing wall thicknesses is warranted. This special standard shall apply only in those specific areas hereinafter defined. The casing specifications adopted in Section 7.2.1 and 7.2.2 of these rules shall govern in all other parts of the affected drainage areas.

11.2.1.2 It shall be the sole responsibility of the water well driller to install casing suitable to the conditions encountered at the well site, in accordance with these minimum specifications.

11.2.1.3 Steel Casing. All steel casing installed under this section shall be new or in like-new condition free from pits or breaks and shall meet the minimum specifications listed in Table 5.

TABLE -5-

WALL THICKNESS FOR STEEL WATER WELL PIPE

Nominal Casing Diameter (Inches)	Minimum Wall Thickness (Inches)
4	0.188
6	0.188
8	0.188
10	0.250
12	0.250
14	0.250
16	0.250
18	0.250
20	0.250

11.2.1.4 Casing Joints. All casing joints shall be made in conformance to Sections 7.3, 7.3.1, and 7.3.2.

11.2.1.5 Applicable Areas. This special standard shall apply only in the specific areas listed below.

71 Area. Those parts of the 71 drainage area in Washington, Iron, and Beaver Counties below an elevation of 6,000 ft. MSL. Those parts of the 71 drainage area in Millard County below an elevation of 5,200 ft. MSL.

73 Area, 75 Area. Those parts of the 73 and 75 drainage areas in Iron County below an elevation of 6,000 ft. MSL.

77 Area. Those parts of the 77 drainage area in Beaver County below an elevation of 6,000 ft. MSL.

:2 ABANDONMENT OF WELLS

12.1 TEMPORARY ABANDONMENT. When any well is temporarily removed from service, the top of the well shall be sealed with a water-tight cap or seal. If the well is temporarily abandoned during construction, it shall be assumed that the well is permanently abandoned after 90 days, and a well driller's report will be submitted in compliance with Section 4.3 of these rules.

12.2 PERMANENT ABANDONMENT. Any well that is to be permanently abandoned shall be completely filled in such a manner as to prevent vertical movement of water within the borehole as well as preventing the annular space surrounding the well casing from becoming a conduit for possible contamination of the groundwater supply.

12.3 LICENSE REQUIRED. Well abandonment shall be accomplished under the direct supervision of a currently licensed water well driller who shall be responsible for verification of the procedures and materials used.

12.4 MATERIALS USED. The following materials may be used in the permanent abandonment of wells:

1) Neat Cement conforming to ASTM standard C150 of sufficient weight (not less than 15 lbs/gallon) to prevent the flow of any water into the hole from any aquifer penetrated.
2) Cement grout consisting of equal parts of cement conforming to ASTM standard C150 and sand/aggregate with no more than 6 gallons of water per sack of cement.
3) Bentonite-based products specifically designed for permanent well abandonment, which are mixed and placed according to manufacturer's recommended procedures (i.e. Plug-Gel, Shur-Gel, etc.).
4) The liquid phase of the abandonment fluid shall be non-saline water containing no chemicals or toxic materials or other substances which may decompose or possibly contaminate the groundwater supply.

12.5 PLACEMENT OF MATERIALS.

1) Neat cement and cement grout shall be introduced at the bottom of the well or required sealing interval and placed progressively upward to the top of the well. Said sealing material shall be placed by the use of a grout pipe, treamie line or dump bailer in order to avoid segregation or dilution of the materials.
2) Bentonite-based products shall be mixed and placed according to manufacturer's recommended procedures.

12.6 TERMINATION OF CASING. The casings of wells to be abandoned shall be severed a minimum of 2 feet below either the natural ground surface adjacent to the well or at the collar of the hole, whichever is the lower elevation. A minimum of 2 feet of compacted native material shall be placed above the abandoned well upon completion.

12.7 REPORT OF ABANDONMENT. Within 30 days of the completion of well abandonment procedures, a report must be submitted to the state engineer by the responsible licensed driller giving data relating to the abandonment of the well. The report shall be made on forms furnished by the state engineer and shall contain such information as he may require, including but not limited to the following:

1) Name of licensed driller or other person(s) performing abandonment procedures.
2) Name of well owner at time of abandonment.
3) Address or location of well by section, township and range.
4) Abandonment materials, equipment and procedures used.
5) Water right or file number covering the well.
6) Final disposition of the well.
7) Date of completion.

12.8 ABANDONMENT OF ARTESIAN WELLS. A cement grout or concrete plug shall be placed in the confining stratum overlying the artesian zone so as to prevent subsurface leakage from the artesian zone. The remainder of the well shall be filled with cement grout, concrete, bentonite products, or puddled clay.

12.9 ABANDONMENT OF DRILLED AND JETTED WELLS. A cement grout or concrete plug shall be placed opposite all perforations or openings in the well casing. The remainder of the well shall be filled with cement grout, concrete, bentonite products, or puddled clay.

12.10 ABANDONMENT OF GRAVEL PACKED WELLS. All gravel packed wells shall be pressure grouted throughout the perforated section of the well casing. The remainder of the well shall be filled with cement grout, concrete, bentonite products, or puddled clay.

12.11 PLUGGED WELLS. If it is desired to remove the well casing during abandonment, the well shall be plugged as the casing is removed. The well shall be plugged with cement grout, concrete, bentonite products, or puddled clay. In the case of gravel packed wells, the entire gravel section shall be pressure grouted.

12.12 REPLACEMENT WELLS. Wells which are to be removed from operation and replaced by the drilling of a new well, under an approved replacement application, shall be abandoned in a manner consistent with the provisions of this section before the rig is removed from the site.

13 WELLS INTENDED FOR PUBLIC DRINKING WATER SUPPLIES

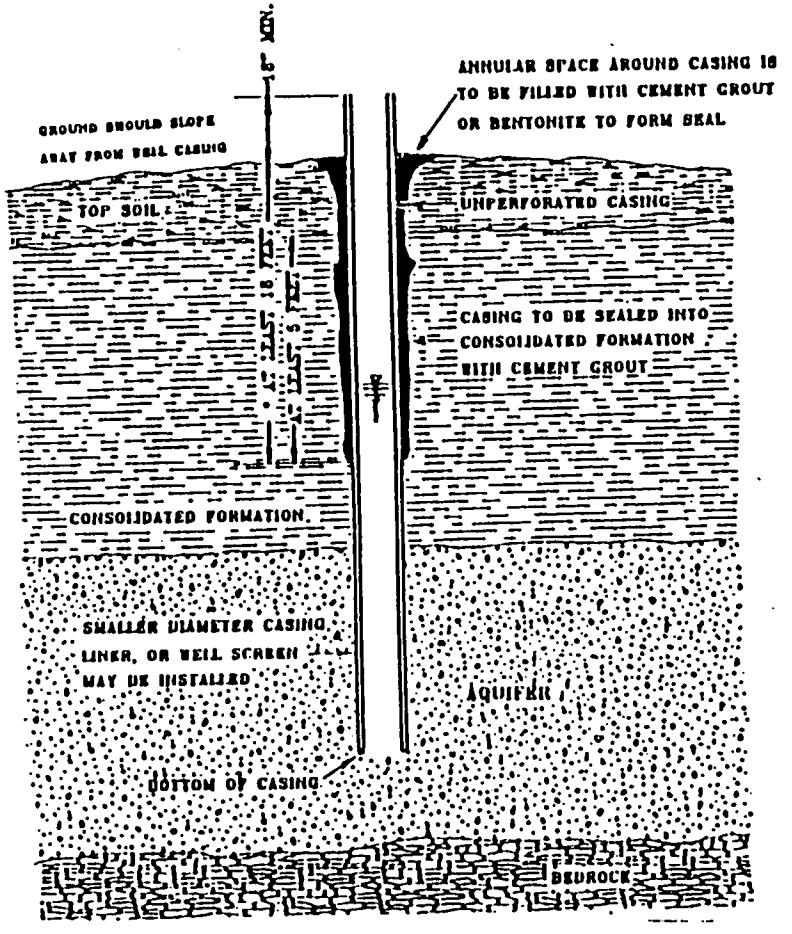
13.1 Each driller shall be familiar with the requirements of the Utah State Department of Health, Bureau of Drinking Water/Sanitation and with respect to public supply wells. Rules governing public drinking water supplies are given in the "State of Utah Public Drinking Water Regulations" available from the Utah State Bureau of Drinking Water/Sanitation and (State Department of Health).

When drilling wells intended for public drinking water use, the driller should be familiar with and acquaint his client with local or state health department rules which require, among other things:

a) Plans and specifications for the well to be reviewed and approved by the Bureau of Drinking Water/Sanitation before construction begins.
b) Minimum grouting distances below the surface.
c) Minimum distances between the well and any concentrated sources of pollution (e.g. septic tanks, septic tank drainfields, garbage dumps, pit privies, drain lines, sewer lines, corrals, feedlots, etc.).

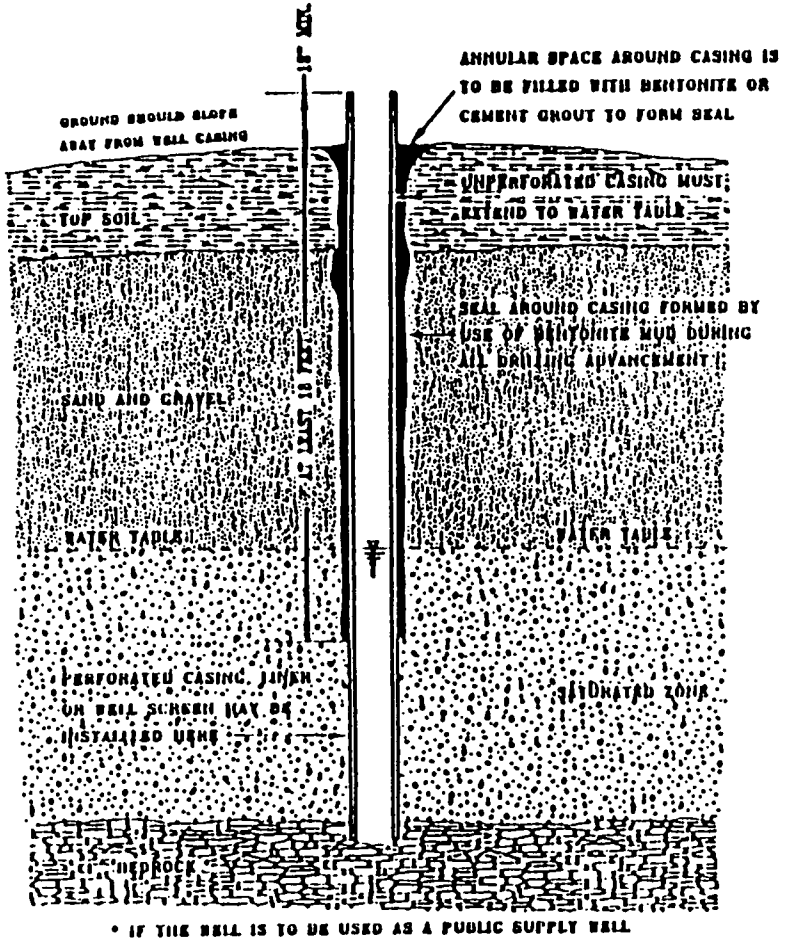
13.2 A representative of the State Engineer's Office or the Bureau of Drinking Water/Sanitation and must be present at the time the surface seal is placed in all public supply wells so that the placement of the seal can be certified. In order to assure that a representative will be available, and to avoid down-time waiting for a representative, notice should be given several days in advance of the projected seal placement. When the time and date are finally set, a definite appointment should be made with the representative.

FIGURE 1: CONSTRUCTION OF A DRILLED WELL
THE AQUIFER IS OVERLAIN BY A
CONSOLIDATED FORMATION



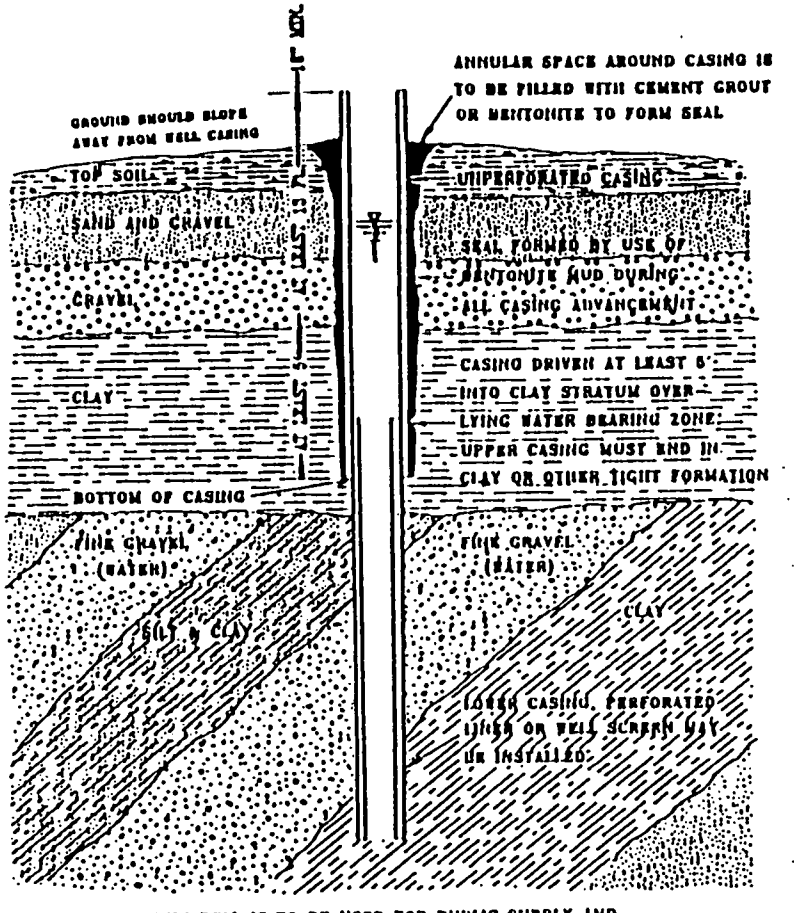
* IF THE WELL IS TO BE USED AS A PUBLIC SUPPLY WELL THE GROUT MUST EXTEND A MINIMUM OF 2" AROUND THE CASING & TO A MINIMUM OF 100' BELOW THE SURFACE

FIGURE 2: CONSTRUCTION OF A DRILLED WELL THE AQUIFER IS OVERLAIN BY A PERMEABLE SAND OR GRAVEL.



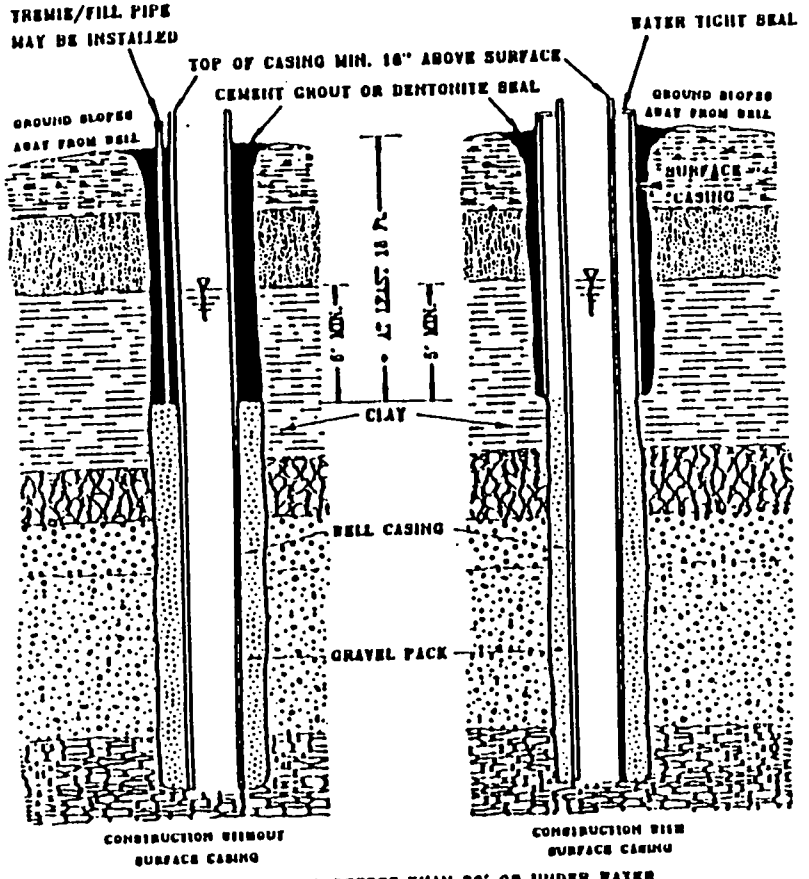
* IF THE WELL IS TO BE USED AS A PUBLIC SUPPLY WELL THE GROUT MUST EXTEND TO A MINIMUM OF 8" AROUND THE CASING & TO A MINIMUM OF 100 FT. BELOW THE SURFACE

FIGURE 3: CONSTRUCTION OF A DRILLED WELL THE AQUIFER IS OVERLAIN BY STRATIFIED FORMATIONS



* IF THE WELL IS TO BE USED FOR PUBLIC SUPPLY AND CLAY LAYER ABOVE PRODUCING ZONE IS AT LEAST 30 FT. THICK, THE GROUT MUST EXTEND FROM THE SURFACE TO A POINT 6 FEET INTO THE CONFINING CLAY LAYER.

FIGURE 4: CONSTRUCTION OF GRAVEL PACKED WELLS INSTALLED WITH AND WITHOUT SURFACE CASINGS



* ALL GROUT PLACED DEEPER THAN 30' OR UNDER WATER SHALL BE PLACED BY TREMIE, PUMPING OR PRESSURE. PUBLIC SUPPLY WELLS MUST BE GROUTED TO 100'.

FIGURE 5: CONSTRUCTION OF DUG WELLS

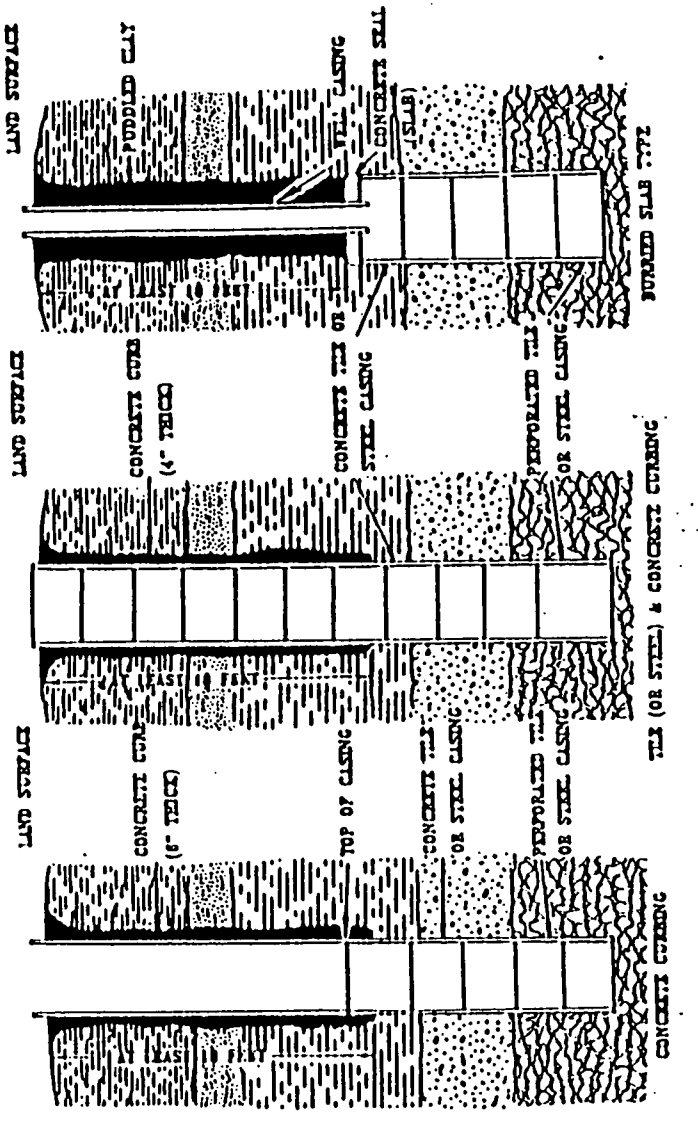
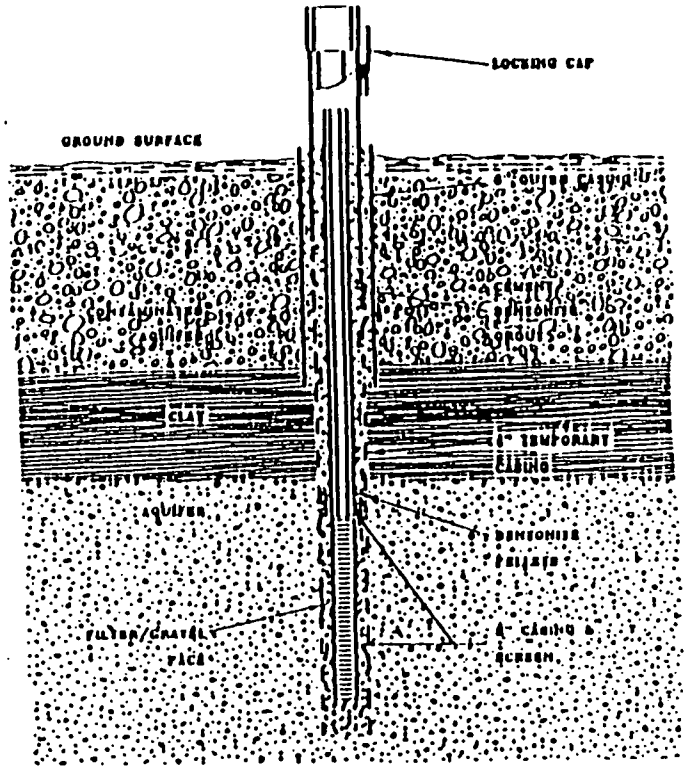


FIGURE 8: CONSTRUCTION OF MONITOR WELL (TYPICAL)



*POTENTIAL CROSS-CONTAMINATION OF AQUIFERS CAN BE ELIMINATED WITH PROPER MONITOR WELL CONSTRUCTION

APPENDIX I

MONITOR WELL INSTALLATION GUIDELINES AND RELATED INFORMATION

GENERAL

Most, if not all, monitor well projects are the result of compliance with EPA, Federal Regulations such as the Resource Conservation & Recovery Act (RCRA) or specific State Solid and Hazardous Waste requirements. The contracts governing their installation are tightly written containing specific requirements as to site location, materials used, sampling procedures and overall objectives. The following monitor well guidelines address only the procedures required to obtain actual approval to drill and the commonly acceptable construction and installation practices for monitor wells.

All monitor wells constructed in the state will be installed by a currently licensed Utah Water Well Driller.

APPROVAL

Approval for monitor well projects are issued by the state engineer following review of written requests from the owner/applicant, federal or state agency or engineering representative. The requests for approval should include the following information:

1) General location or common description of the monitoring project.
2) Specific course and distance locations of all requested locations (or location by 1/4, 1/4 section)
3) Total anticipated number of wells to be installed.
4) Diameters, approximate depths, materials used, in the wells.
5) Projected start and completion dates.
6) Name and license number of driller contracted to install the wells.

Upon written approval by the state engineer, the project will be assigned an approved authorization number which will be referenced by the licensed driller on all start cards and well drillers reports as required by Sections 4.1.1 and 4.3 of these Rules.

INSTALLATION

All material used in the installation of monitor wells should be sterile and contaminant free when placed in the ground. During construction contaminated water should not be allowed to enter contaminant-free geologic formations or water bearing zones. Some minor cross-contamination may occur during drilling, but the integrity of the borehole and individual formations must then be safeguarded. The well casing should be perforated or screened and filter packed with sand or gravel where necessary to provide adequate sample collection at depths where appropriate aquifer flow zones exist. The annular space between the borehole and casing should be adequately sealed using bentonite-slurry, pellets or cement grout. The gravel or filter pack should generally extend 2 ft. to 10 ft. above the screened or perforated area to prevent the migration of the sealing material from entering the zones being sampled. Drill cutting should not be placed into the open borehole annulus.

DRILLING METHODS

Monitor wells may be installed using a variety of commonly recognized drilling methods. The method used should minimize the disturbance of subsurface materials and consequently reduce possible cross-contamination of groundwater zones. The drilling method is a function of the site specific geologic conditions which may make one method more suitable than another. Regardless of the method used, the well rig and support equipment should be steam cleaned and decontaminated before use and between borehole locations to prevent cross-contamination of wells.

All methods employed in monitor well construction have inherent advantages and disadvantages which can be compared in Table 6.

TABLE 6

DRILLING METHODS FOR MONITOR WELLS

Type	Advantages	Disadvantages
Mud Rotary	*Readily available *Capable of drilling hard or soft formations. *Core sampling available *No depth restrictions *Small rigs for accessibility *Logging fairly reliable *Relatively inexpensive	*Drilling fluid invades formation; hard to remove *Bentontic fluids absorb metals *Organic fluids interfere with bacterial/organic analysis *Limited information on water zones *Drilling fluids circulate contaminants
Air Rotary	*No drilling fluid-reduced contamination *Used in consolidated & unconsolidated formations *No depth restrictions *Excellent sampling in hard, dry formations *Easy collection & field analysis of blown water *Fast & readily available.	*Casing required in soft, caving formations *Multiple water zones-difficult to properly case and grout off different zones *Relatively expensive
Air Rotary with Casing Hammer	*Caving formations can be drilled *Multiple levels can be penetrated & sampled	*Limited availability *Higher operating costs *Casing pull-back is difficult

Cable Tool	*Small amounts of water required-no fluid additives *Used in consolidated & unconsolidated formations *No depth restrictions *Good formation samples *Observed water level changes *Good seal between casing & formation *Inexpensive operation	*4-inch minimum casing size *Limited geophysical logs *Relatively slow
Reverse Circulation (Dual Wall Pipe)	*Formation water not contaminated by drilling water *Excellent formation samples *With air - immediate information on water bearing zones *Reduced caving of hole	*Rare - expensive to operate *Difficult grout placement outside casing - above screen
Hollow-Stem (Continuous Flight Auger)	*Mobile, fast, inexpensive to operate in unconsolidated formations *No drilling fluid-reduced contamination *Reduced caving problems-casing & screen placement inside of augers *Gamma Ray logging inside hollow stem-nature & thickness of formations *Continuous placement of grout seal as augers are removed.	*Limited depth - usually 100 - 150 ft. *Not used in consolidated, rock formations *Limited accuracy of samples *Depth to water table difficult to determine in deep borings
Solid Stem Auger	*Mobile, fast, inexpensive to operate in unconsolidated formations *No drilling fluid-reduced contamination	*Not used in rock formations *Limited depth, 100-150 ft. *Difficult to maintain open hole, especially below water table *Limited accuracy of samples

MATERIALS USED

Casing & Screens

There are several materials currently approved for the use in the installation of monitor wells. Most of the monitor project contracts will specify which materials are to be used based on the anticipated pollutants being monitored. The cost of the materials varies greatly, and it may be realistic to balance sample accuracy with overall cost, especially in regard to casing and intake portions of well construction. There are some exotic materials being developed for monitor well use; however, the more common casing and screen materials now being used and their advantages and disadvantages can be compared in Table 7.

TABLE 7

MONITOR WELL CASING & SCREEN MATERIALS

Type	Advantages	Disadvantages
PVC	*Lightweight, readily available *Lower cost than Teflon or stainless steel *Good resistance to mineral or oxidizing acids & alkalies	*Weaker, less rigid, more temperature sensitive than metallic materials *May react & leach constituents from groundwater *Poor resistance to ketones, esters, & aromatic hydrocarbons
Polypropylene	*Lightweight, chemically resistant to mineral acids, alkalies, ketones, alcohols, esters, oils *Fair resistance to oxidizing acids, aliphatic hydrocarbons, & aromatic hydrocarbons *Lower cost than Teflon & stainless steel	*Same as PVC and may leach constituents into groundwater *Poor machinability - cannot be slotted because it melts rather than cuts
Teflon	*Lightweight, high impact strength *Outstanding chemical resistance, insoluble in all organics but few fluorinated solvents	*Low tensile strength & low wear resistance *Expensive relative to other plastics & stainless steel

Kynar	*Greater strength & water resistance than Teflon *Lower cost than Teflon	*Not readily available *Poor resistance to acetone & ketones
Mild Steel	*Strong, rigid, temperature sensitivity not a problem *Low cost, readily available *Lower cost than stainless steel or Teflon	*Heavier than plastics *May react & leach constituents into groundwater *Not as chemically resistant as stainless steel
Stainless Steel	*High strength & temperature range *Resistant to corrosion & oxidation *Readily available *Moderate cost	*Heavier than plastics *May leach chromium in highly acidic water *May be catalyst in some organic reactions *Screens higher cost than plastic

SEALING MATERIALS

Bentonite pellets are commonly used above the filter or gravel pack with a bentonite slurry or cement grout filling the annulus above to within a few feet of the surface. A concrete seal is then placed at the surface which slopes away from the well casing. The final well should be equipped with a vented locking protective cap or cover.

WELL DEVELOPMENT

Hydraulic efficiency is generally not an overriding consideration in monitor well construction as it is with high capacity production water wells. However, development of monitor wells is necessary, especially in low permeability formations, to allow free movement of water into the sampling areas. The development process for monitor wells is best accomplished by causing the natural formation water inside the screened or perforated area to move vigorously in and out in order to agitate and remove silt, clay, and fines. The use of water other than natural formation water is not recommended as results of sampling may become altered.

Several suitable methods for developing monitor wells include using a surge block or bailer or surging by pumping or air lift.

SUMMARY

These guidelines and recommended practices dealing with the installation of monitor wells are not meant to represent a complete authority. There are several excellent sources of information available concerning monitor well installations and requirements. One additional recommended information source is the EPA's Resource Conservation & Recovery Act (RCRA) Ground Water Monitoring Enforcement & Compliance Document available from EPA's regional office in Denver, Colorado or the National Water Well Association's Publication Department.

APPENDIX II

RECOMMENDATIONS FOR WATER WELL SYSTEM DISINFECTION

A new well or one that has been repaired or modified should be assumed to be contaminated. This contamination must be removed prior to placing the well into use to protect the health of those who may use the well. The entire well system, casing, pumps, distribution system, etc., must be disinfected.

Well cleaning is a necessary part of well construction. Grease, oil, soil, and other foreign substances can harbor and protect bacteria from subsequent disinfection. Generally mechanical extraction, swabbing, and pumping have proven effective for cleaning most wells in most situations.

After the well has been cleaned, the two most important factors in disinfecting a well system are the concentration of the disinfectant and the duration of the contact of the disinfectant with any contaminated surface. Generally, the stronger the disinfectant solution is, the shorter the contact can be.

Any and all parts of the water well system may be contaminated. Therefore, all parts of the system must be exposed to the disinfectant solution for a sufficient amount of time to insure that the contamination has been neutralized.

Below is one method of disinfecting a water well system.

1. The well system should be completely assembled and in a fully operable condition.

2. Run the system to waste long enough to remove all stagnant or cloudy water. All taps should be opened to flush out the plumbing system. Turn off the pump.

3. Introduce the concentrated solution directly into the well. Some scheme must be used to insure uniform vertical distribution below the water level. Dry chemicals shall be placed in a mechanical carrier and slowly raised and lowered from the bottom of the well to the static water surface until the chemical has dissolved. Liquids or dry chemicals mixed with water to form a concentrated liquid shall be introduced by use of a hose or pipe from the bottom of the well to the static water surface.

4. Circulate the water with the disinfectant in it throughout the well system. Most of the flow should be returned to the well for recirculation. When returning water to the well, the flow should be directed to the well casing so as to completely wet that portion above the static water level. Make certain that water containing the disinfectant has been introduced throughout the system including all pipelines, storage tanks and taps.

5. All taps should be closed and the pump turned off. The disinfectant should be allowed to remain in the system as long as practical, at least 8 hours is recommended.

6. After the disinfectant solution has been in the system at least 8 hours, the water and disinfectant can be pumped to waste.

If the well has a proper surface seal and any polluted groundwater has been sealed out, the system should remain sanitary until it is repaired or otherwise disturbed. A laboratory can analyze a water sample taken at this time to determine if dangerous levels of contamination still exist.

Table 3 gives the amount of hypercholrite needed to disinfect wells of various diameters.

NOTE: Further information on disinfecting wells is available in AWWA specification A-100, AWWA Standard for Deep Wells.

APPENDIX III

SELECTED WATER LAWS OF UTAH
DEALING WITH GROUNDWATER AND APPROPRIATION

Utah Code Annotated 1953, Title 73,
Selected Sections

Sections 73-3-22 to 73-3-26 inclusive, Utah Code Annotated, 1953, have been amended by House Bill 1 1987 (Statutes are effective April 27, 1987) to read as follows:

73-3-22 WELL DRILLER REPORTS

(1) Any person constructing a well or tunnel for the purpose of utilizing or monitoring underground waters shall,within 30 days after the completion or abandonment of the construction, report to the state engineer data relating to each well or tunnel. The report shall be made on forms furnished by the state engineer and shall contain information required by the state engineer.
(2) Any person who fails to comply with the provisions of this section is guilty of a class B misdemeanor.

73-3-23 DEFINITIONS

As used in this chapter:
(1) "Well" means an excavation or opening into the ground made by digging, boring, drilling, jetting, or driving or any other artificial method for utilizing or monitoring underground waters.
(2) "Well driller" means any person that constructs a well for compensation or otherwise.
(3) "Well drilling" means the act of constructing, repiring, or deepening a well, including all incidental work.

73-3-25 LICENSE AND BONDING REQUIREMENTS

(1) Every person that constructs a well in the state shall obtain a license from the state engineer. The application for a license shall be in a form prescribed by the state engineer. All well driller's licenses expire on the 31st day of December following their issuance and are not transferable. The state engineer is authorized and directed to prepare and keep on file in his office rules for well construction.
(2)(a) No person may construct a well in this state without first obtaining a license as provided in this section. No well driller's license will be issued without the applicant filing a $5000.00 penal bond with the state engineer. The bond shall be made payable to the Office of the State Engineer. Proper compliance with the provisions of this section are required to obtain or renew a license.
(b) Well drillers are required to comply with the rules promulgated by the state engineer under this chapter. If the state engineer determines, following an investigation and a hearing upon

at least ten days' notice to the licensee, by registered mail, that the licensee has failed to comply with these rules, the state engineer may revoke or suspend the license, and exact the bond and deposit the money in a nonlapsing dedicated credit. The state engineer may expend the funds to investigate or correct any deficiencies which could adversely affect the public interest resulting from noncompliance with the rules promulgated under this chapter by any well driller. The state engineer may refuse to issue a license to a well driller if it appears that there has been a violation of the rules or a failure to comply with Section 73-3-22.

(c) An order of the state engineer suspending, revoking, or refusing to issue a license is final unless an action to review his decision is filed within the time and in the manner provided by Section 73-3-14.

73-3-26 VIOLATION AND PENALTIES

(1) Any person that does any of the following is guilty of a Class B misdemeanor:
   (a) Constructs a well without first obtaining a license as required by this chapter;
   (b) Advertises to be a well driller without first obtaining a license as required by this chapter;
   (c) Constructs a well after suspension, revocation or expiration of his license;
   (d) Constructs a well in violation of the rules promulgated under Subsection 73-3-25 (1);
(2) Each day of failure to comply with the provisions of this section constitutes a separate offense.

73-1-1 WATERS DECLARED PROPERTY OF PUBLIC

All waters in this state, whether above or under the ground are hereby declared to be the property of the public, subject to all existing rights to the use thereof.

73-1-2 UNIT OF MEASUREMENT - OF FLOW - OF VOLUME

The standard unit of measurement of the flow of water shall be the discharge of one cubic foot per second of time, which shall be known as a second foot; and the standard unit of measurement of the volume of water shall be the acre foot, being the amount of water upon an acre covered one foot deep, equivalent to 43,560 cubic feet.

73-1-3 BENEFICIAL USE BASIS OF RIGHT TO USE

Beneficial use shall be the basis, the measure and the limit of all rights to the use of water in this state.

73-3-1 APPROPRIATION - MANNER OF ACQUIRING WATER RIGHTS

Rights to the use of the unappropriated public waters in this state may be acquired only as provided in this title. No appropriation of water may be made and no rights to the use thereof initiated and

no notice of intent to appropriate shall be recognized except application for such appropriation first be made to the state engineer in the manner hereinafter provided, and not otherwise. The appropriation must be for some useful and beneficial purpose, and, as between appropriators, the one first in time shall be first in rights; provided, that when a use designated by an application to appropriate any of the unappropriated waters of the state would materially interfere with a more beneficial use of such water, the application shall be dealt with as provided in section 73-3-8. No right to the use of water either appropriated or unappropriated can be acquired by adverse use or adverse possession.

73-3-2 APPLICATION FOR RIGHT TO USE UNAPPROPRIATED PUBLIC WATER NECESSITY - FORM - CONTENTS - VALIDATION OF PRIOR APPLICATIONS BY STATE OF UNITED STATES OR OFFICER OR AGENCY THEREOF

Any person who is a citizen of the United States, or who has filed his declaration of intention to become such as required by the naturalization laws, or any association of such citizens or declarants, or any corporation, or the state of Utah by the directors of the divisions of travel development, industrial promotion, fish and game, and state lands or the chairman of the state road commission for the use and benefit of the public, or the United States of America, in order hereafter to acquire the right to the use of any unappropriated public water in this state shall, before commencing the construction, enlargement, extension or structural alteration of any ditch, canal, well, tunnel or other distributing works, or performing similar work tending to acquire such rights or appropriation, or enlargement of an existing right or appropriation, make an application in writing to the state engineer. Such application shall be upon a blank to be furnished by the state engineer, and shall set forth the name and post-office address of the person, corporation or association making the application; the nature of the proposed use for which the appropriation is intended; the quantity of water in acre-feet or the flow of water in second-feet to be appropriated, and the time during which it is to be used each year; the name of the stream or other source from which the water is to be diverted; the place on such stream or source where the water is to be diverted and the nature of the diverting works; the dimensions, grade, shape and nature of the proposed diverting channel; and such other facts as will clearly define the full purpose of the proposed appropriation. If the proposed use is for irrigation, the application shall show the legal subdivisions of the land proposed to be irrigated, with the total acreage thereof and the character of the soil. If the proposed use is for developing power, the application shall show the number, size and kind of water wheels to be employed and the head under which each wheel is to be operated; the amount of power to be produced and the purposes for which and the place where it is to be used; also the point where the water is to be returned to the natural stream or source. If the proposed use is for milling or mining, the application shall show the name of the mill and its location or the name of the mine and the mining district in which it is situated, its nature, and the place where the water is to be returned to the natural stream or source. The point of diversion

and the point of return of the water shall be designated with reference to the United States land survey corners, mineral monuments, or permanent federal triangulation or traverse monuments, when either the point of diversion or the point of return is situated within six miles of such corners and monuments. If the point of diversion or point of return is located in unsurveyed territory, such point may be designated with reference to a permanent, prominent natural object. The storage of water by means of a reservoir shall be regarded as a diversion, and the point of diversion in such cases shall be the point where the longitudinal axis of the dam crosses the center of the stream bed. The point where released storage water is taken from the stream shall be designated as the point of rediversion. The lands to be inundated by any reservoir shall be described as nearly as may be, and by government subdivision, if upon surveyed land, the height of the dam, the capacity of the reservoir, and the area of the surface thereof when the reservoir is filled shall be given. If the water is to be stored in an underground area or basin, the applicant shall designate, with reference to the nearest United States land survey corner if situated within six miles thereof, the point of area of intake, the location of such underground area or basin and the points of collection therefrom.

Applications for the appropriation of water filed prior to the enactment thereof, by the United States of America, or any officer or agency thereof, or the state of Utah, or any officer or agency thereof, are validated, subject to any action thereon by the state engineer.

73-3-3 CHANGE OF PLACE OF DIVERSION OR USE RIGHT TO - PERMANENT OR TEMPORARY - APPLICATION - CONTENTS - INVESTIGATION - NOTICE AND HEARING - DEPOSIT TO COVER EXPENSES - FINALITY OF DECISION - VIOLATION AS MISDEMEANOR - EXCEPTION AS TO REPLACEMENT WELLS

Any person entitled to the use of water may change the place of diversion or use and may use the water for other purposes than those for which it was originally appropriated, but no such change shall be made if it impairs any vested right without just compensation. Such changes may be permanent or temporary. Changes for an indefinite length of time with any intention to relinquish the original point of diversion, place or purpose of use are defined as permanent changes. Temporary changes include and are limited to all changes for definitely fixed periods of not exceeding one year. Both permanent and temporary changes of point of diversion, place or purpose of use of water including water involved in general adjudication or other suits, shall be made in the manner provided herein and not otherwise.

No permanent change shall be made except on the approval of an application therefor by the state engineer. Such applications shall be made upon blanks to be furnished by the state engineer and shall set forth the name of the applicant, the quantity of water involved, the stream or source from which the appropriation has been made, the point on the stream or source where the water is diverted, the point to which it is proposed to change the diversion

of the water, the place, purpose and extent of the present use, and the place, purpose and extent of the proposed use and such other information as the state engineer may require. The procedure in the state engineer's office and rights and duties of the applicants with respect to applications for permanent changes of point of diversion, place or purpose of use shall be the same as provided in this title for applications to appropriate water; but the state engineer may, in connection with applications for permanent change involving only a change in point of diversion of 660 feet or less, waive the necessity for publishing notice of such applications. No temporary change shall be made except upon an application filed in duplicate with the state engineer upon forms to be provided by him, which shall set forth the name of the water user, a description of his water right, the nature and time of the change sought, the reason for the change, and such other information as the state engineer may require. The state engineer shall make an investigation, and if such temporary change does not impair any vested rights of others, he shall make an order authorizing the change. If he shall find that the change sought might impair such rights, he shall give notice of the application to all persons whose rights may be affected thereby and shall give them an opportunity to be heard before authorizing the change. Such notice may be given by regular mail five days before the hearing or by one publication in a newspaper of general circulation in the county in which the original point of diversion or place of use is located five days before such hearing. Before making an investigation or giving notice the state engineer may require the applicant to deposit a sum of money sufficient to pay the expenses thereof.

Applications for either permanent or temporary changes shall not be rejected for the sole reason that such change would impair vested right of others, but if otherwise proper, they may be approved as to part of the water involved or upon condition that such conflicting rights be acquired.

Any person holding an approved application for the appropriation of water may in like manner, either permanently or temporarily change the point of diversion, place or purpose of use, but no such change of approved application shall affect the priority of the original application; provided, that no change of point of diversion, place or nature of use set forth in an approved application shall operate to enlarge the time within which the construction of work shall begin or be completed. The determination of the state engineer shall be final, unless an action to review his decision is filed within the time and in the manner provided by section 73-3-14.

Any person who changes or who attempts to change a point of diversion, place or purpose of use, either permanently or temporarily without first applying to the state engineer in the manner herein provided, shall obtain no right thereby and shall be guilty of a misdemeanor, each day of such unlawful change constituting a separate offense, separately punishable.

The provisions of this section shall not apply to the replacement of an existing well by a new well drilled within a radius of 150

feet from the point of diversion from said existing well, and no such replacement well shall be drilled except upon compliance with the requirements of section 73-3-28.

73-3-5.5 TEMPORARY APPLICATIONS TO APPROPRIATE WATER - APPROVAL BY ENGINEER - NOTICE AND HEARING - EXPIRATION - PROOF OF APPROPRIATION NOT REQUIRED

1) The state engineer may issue temporary applications to appropriate water for beneficial purposes. The provisions of this chapter governing regular applications to appropriate water shall apply to temporary applications with the following exceptions:

a) The state engineer shall undertake a thorough investigation of the proposed appropriation, and if such temporary application complies with the provisions of section 73-3-8, may make an order approving the application. If the state engineer shall find that the appropriation sought might impair other rights, the state engineer shall give notice of the application to all persons whose rights may be affected thereby and shall give them an opportunity to be heard before approving the application. The notice may be given by regular mail five days before the hearing or by one publication in a newspaper of general circulation in the county in which the point of diversion is located.
b) The state engineer may issue a temporary application for a period of time not exceeding one year.
c) The state engineer, in the approval of a temporary application, may make approval subject to such conditions and provisions as the state engineer deems necessary to fully protect prior existing rights. If, in the judgment of the state engineer, it is necessary to have a water commissioner distribute the water under a temporary application for the protection of other vested rights, the state engineer may assess the distribution costs against the holder of the temporary application.
d) A temporary application does not vest in its holder a permanent vested right to the use of water, and a temporary application automatically expires and is cancelled in accordance with its terms.
e) Proof of appropriation required under this chapter shall not apply to temporary applications.

73-3-8 APPROVAL OR REJECTION OF APPLICATION - REQUIREMENTS FOR APPROVAL - APPLICATION FOR SPECIFIED PERIOD OF TIME - FILING OF ROYALTY CONTRACT FOR REMOVAL OF SALT OR MINERALS

1)It shall be the duty of the state engineer to approve an application if: (a) there is unappropriated water in the proposed source; (b) the proposed use will not impair existing rights or interfere with the more beneficial use of the water; (c) the proposed plan is physically and economically feasible, unless the application is filed by the United States Bureau of Reclamation, and would not prove detrimental to the public welfare; (d) the applicant has the financial ability to complete the proposed works; and (e) the application was filed in good faith and not for purposes of speculation or monopoly. If the state engineer,

because of information in his possession obtained either by his own investigation or otherwise, has reason to believe that an application to appropriate water will interfere with its more beneficial use for irrigation, domestic or culinary, stock watering, power or mining development or manufacturing, or will unreasonably affect public recreation or the natural stream environment, or will prove detrimental to the public welfare, it is his duty to withhold his approval or rejection of the application until he has investigated the matter. If an application does not meet the requirements of this section, it shall be rejected.

2) An application to appropriate water for industrial, power, mining development, manufacturing purposes, agriculture, or municipal purposes may be approved for a specific and certain period from the time the water is placed to beneficial use under the application, but in no event may an application be granted for a period of time less than that ordinarily needed to satisfy the essential and primary purpose of the application or until the water is no longer available as determined by the state engineer. At the expiration of the period fixed by the state engineer the water shall revert to the public and is subject to appropriation as provided by Title 73. The state engineer may extend any limited water right upon a showing that the essential purpose of the original application has not been satisfied, that the need for an extension is not the result of any default or neglect by the applicant, and that water is still available; except no extension shall exceed the time necessary to satisfy the primary purpose of the original application. A request for extension must be filed in writing in the office of the state engineer not later than 60 days before the expiration date of the application.

3) Before the approval of any application for the appropriation of water from navigable lakes or streams of the state which contemplates the recovery of salts and other minerals therefrom by precipitation or otherwise, the applicant shall file with the state engineer a copy of a contract for the payment of royalties to the state of Utah. The approval of an application shall be revoked in the event of the failure of the applicant to comply with terms of his royalty contract.

73-3-23 REPLACEMENT OF WATER

In all cases of appropriation of underground water the right of replacement is hereby granted to any junior appropriator whose appropriation may diminish the quanity or injuriously affect the quality of appropriated underground water in which the right to the use thereof has been established as provided by law. No replacement may be made until application in writing has been made to and approved by the state engineer. In all cases replacement shall be at the sole cost and expense of the application and subject to such as the state engineer may prescribe. The right of eminent domain is hereby granted to any applicant for the purpose of replacement as provided herein.

73-3-27 REQUESTS FOR SEGREGATION OF PENDING APPLICATIONS

Upon request in writing and approval by the state engineer, applications to appropriate or to permanently change the point of diversion, place or purpose of use of water may be divided or segregated into two or more separate parts; provided such request shall be made upon blanks to be furnished by the state engineer and shall include the serial number of the application to be segregated, the name, post-office address of the owner of the application, a statement of the nature of the proposed division or segregation, the reasons therefor, and such other information as the state engineer may require.

Action taken by the state engineer on applications for appropriation or permanent change prior to segregation, shall be applicable in all respects to the segregated parts thereof. Upon segregation the original and each segregated part shall be treated as separate applications. The approval of a request for segregation shall not confirm the validity or good standing of the segregated application or extend the time for the construction of works. Action of the state engineer upon requests for segregation taken prior to the effective date of this act is approved and confirmed.

Requests for segregation shall be rejected if the approval thereof would impair rights or would prove detrimental to the public welfare.

73-3-28 REPLACEMENT WELLS - DEFINITION OF - REQUIREMENTS - STATE ENGINEER'S APPROVAL - APPLICATION TO DRILL - FILING - FORM - CONTENTS - NOTICE - FEES - PLUGGING OF OLD WELL

An existing well may be replaced with a replacement well within a radius of 150 feet from the existing well without the filing of a change application under section 73-3-3, upon approval first having been obtained from the state engineer.

Such request for permission to drill a replacement well shall be filed with the state engineer upon a blank to be furnished by the state engineer. Such blank shall contain, but need not be limited to, the name and postoffice address of the person, corporation or association making the request, the number of the claim or application filed with the state engineer covering the well which is being replaced, the number of the award if, in a decree, the reason for the replacement, the location of the replacement well with reference to the nearest United States land survey corner, and from the old well, and the name of the driller employed by the applicant to do the work.

No filing fee shall be required for the filing of such a request for permission to drill a replacement well, and the state engineer need give only such notice as, in his judgment, is necessary to protect existing rights, and in the event the state engineer shall

determine that it is necessary to publish notice, the advertising fee shall be paid in advance by the applicant.

The term "replacement well" as used herein means a new well drilled for the sole purpose of replacing an existing well which is impaired or made useless by structural difficulties and no new right in the use of water accrues. Upon completion of the new well the old well must be plugged by the applicant in a manner satisfactory to the state engineer.

73-5-9 POWERS OF STATE ENGINEER AS TO WASTE, POLLUTION OR CONTAMINATION OF WATERS

To prevent waste, loss, pollution or contamination of any waters whether above or below the ground, the state engineer may require the repair or construction of head gates or other devices on ditches or canals, and the repair or installation of caps, valves or casings on any well or tunnel or the plugging or filling thereof to accomplish the purposes of this section.

Any requirement made by the state engineer in accordance with this section shall be executed by and at the cost and expense of the owner, lessee or person having control of such diverting works affected. If within 10 days after notice of such requirement as provided in this section, the owner, lessee or person having control of the water affected, has not commenced to carry out such requirement, or if he has commenced to comply therewith but shall not thereafter proceed diligently to complete the work, the state engineer may forbid the use of water from such source until the user thereof shall comply with such requirement. Failure to comply with any requirement made by the state engineer in accordance with the provisions of this section shall constitute a misdemeanor. Each day that such violation is permitted to continue shall constitute a separate offense.

Copy No. _____

CHEM-NUCLEAR GEOTECH

MONTICELLO REMEDIAL ACTION PROJECT
PROGRAMMATIC HEALTH AND SAFETY PLAN

REVISION 1: FEBRUARY 1991

SIGNATURE SHEET FOR MONTICELLO REMEDIAL ACTION PROJECT PROGRAMMATIC HEALTH AND SAFETY PLAN

Issued By: David L. Scheuerman — David L. Scheuerman, Project Manager — 2-28-91 Date

Concurred With: T. R. Richards — Thomas R. Richards, Manager, Operational Health & Safety — 2-28-91 Date

Concurred With: Travis L Best — Travis Best, Manager, Health Safety & Security — 3-1-91 Date

Approved By: Harry A. Perry — Harry A. Perry, Program Manager — 3-1-91 Date

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SECTION 1-INTRODUCTION

1.1 POLICY

a. Chem-Nuclear Geotech (Geotech) strives to provide a safe and healthful work environment for its employees. Geotech considers the prevention of illness and injury in the workplace to have greater importance than any other facet of our work.

b. Safety will always take precedence over expediency or shortcuts, and every attempt will be made to reduce the possibility of injury, illness, or accident occurrence.

1.2 PURPOSE

a. Assign Geotech employees health and safety responsibilities.

b. Define the potential exposure hazards associated with the work to be performed.

c. Identify prerequisite training and medical surveillance requirements for supervisors, workers and visitors to the Monticello Remedial Action Project (MRAP).

d. Establish Standard Operating Procedures (SOP) applicable to health and safety, requiring mandatory compliance by all Geotech and subcontractor employees, for use when performing work in the controlled areas.

e. Prescribe personal protective equipment requirements for each task type or situation that warrants its use.

f. Establish emergency response procedures for spill cleanup and abatement, personnel injury or illness.

g. Provide a mechanism for written addenda to the MRAP Program Health and Safety Plan (HSP) when the scope of the work changes, the need for personal protection changes, or additional procedures require implementation.

Note: The Project Manager (PM) will initiate the preparation of any addendum. Prior to implementation, the addendum will require the approval of the managers of HS&S.

1.3 PROGRAMMATIC HSPs and SITE-SPECIFIC HSPs

a. This MRAP Program HSP addresses the programmatic requirements contained in UOSHA R500-108-120, 29 CFR 1910.120, and all additional DOE health and safety requirements. Site-specific HSPs are being developed as necessary to address the individual phases of the MRAP Program. The site-specific HSPs will address the following required topics:

1. A safety and health hazard analysis for each major site task and operation.

2. Specific employee training assignments which will assure compliance with UOSHA and our programmatic requirements.

3. Personal protective equipment assignments by task for the employees at the site.

4. Specific medical surveillance requirements which will assure compliance with UOSHA, DOE, and our programmatic requirements.

5. An air monitoring strategy detailing the frequency and types of air monitoring required to be performed during the accomplishment of the identified tasks.

6. Specific site control measures to be used including: the establishment of "Controlled Areas" based on the hazards present at the site, the use of the "buddy system", and the specific communications systems to be used.

7. Decontamination procedures employed for personnel, equipment, and area decontamination.

8. An emergency response plan addressing standard operating procedures for all foreseen emergency situations.

9. Confined space entry procedures for identified tasks within confined spaces.

10. Spill containment procedures for identified tasks that could result in an uncontrolled spill.

b. A consolidated Geotech *Health and Safety Program Plan for Hazardous Waste Operations (Program)* that will be used as Geotech policy at any hazardous waste site operation is being finalized. When final, the MRAP Programmatic HSP will be the implementing document for MRAP and for the Monticello Vicinity Properties Project (MVP). Site-specific HSPs written for specific MRAP tasks will be attached to the MRAP Programmatic HSP. The following table identifies a preliminary list of MRAP tasks for which site-specific HSPs will be developed. Site-specific HSPs will be finalized prior to the anticipated start date of each task, as identified below. If tasks or schedules change, a new list will be provided as an addendum to this document or to the *Program*, whichever is being utilized.

Table 1-1

Preliminary List of Tasks and Timeframes for Health and Safety Plan Completion

Task	Approximate Start Date
Millsite Characterization	4/91
Characterization of BLM Compound	Unscheduled
Closure of the AEC Wells	6/91
Site Preparation @ Millsite	3/92
Site Preparation @ Repository	3/93
Excavation and Placement of Tailings	3/94
Remediation of Peripheral Properties (except BLM Compound)	3/92
Remediation of BLM Compound	Unscheduled

Repository characterization, currently scheduled for March 1991, will be performed in a clean area. A health and safety plan addressing physical hazards has been prepared, but an OSHA site-specific plan is not required.

1.4 COMPLIANCE

a. This HSP complies with all known Utah Occupational Safety and Health Administration (UOSHA) regulations and is based on direction given in 29 CFR 1910.120 (1910.120).

b. This HSP complies with Geotech Health and Safety Policies and Procedures.

c. Several DOE Orders require Geotech to comply with the OSHA and UOSHA regulations. The DOE Orders that apply are outlined below and are located at the Geotech Project Office in Monticello. Of applicable UOSHA and OSHA regulations, the stricter of the two apply.

1. DOE 5483.1A *Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities* requires that DOE Contractors at Government-Owned, Contractor-Operated Facilities comply with OSHA 1910 and OSHA 1926 as applied to their work.

2. DOE 5480.4 *Environmental Protection, Safety, and Health Standards* clarifies the DOE voluntary compliance policy. All DOE Contractors are required to comply with the Mandatory ES&H Standards (Statutory and Policy Requirements). Reference ES&H Standards are also provided for more guidance to the Contractors. These regulations cover the protection of employees, the public, and the environment from hazards that may arise because of DOE sponsored activities.

3. DOE 5480.10 *Contractor Industrial Hygiene Program* requires that contractors have an effective Industrial Hygiene Program based on the Mandatory Standards of DOE 5480.4. The Mandatory Standards listed in Attachment 2 of DOE 5480.4 include OSHA 1910 and OSHA 1926.

d. This HSP complies with the requirements of OSHA and UOSHA because of the DOE policy that its contractors comply with OSHA and UOSHA regulations. This HSP also includes other health and safety requirements of the DOE. These other requirements come from the DOE Orders that apply to Geotech work at hazardous waste sites. The DOE Orders that apply include:

1. DOE 5000.3, *"Unusual Occurrence Reporting System."*

2. DOE 5480.1B, *"Environmental Safety and Health Program for Department of Energy Operations."*

3. DOE 5480.8, *"Contractor Occupational Medical Program."*

4. DOE 5480.9, *"Construction Health and Safety Program."*

5. DOE 5480.10, *"Contractor Industrial Hygiene Program."*

5. DOE 5480.11, *"Radiation Protection for Occupational Workers."*

6. DOE ID 5480.1 Chapter XI, *"Radiation Protection for Occupational Workers."*

1.5 APPLICABILITY

a. The provisions of the MRAP HSP Program are mandatory for all Geotech personnel, subcontractors, and visitors within the controlled areas of this project. Subcontractors will either refer to or incorporate these requirements into their own HSPs.

1.6 HISTORY

a. In late 1940, the Vanadium Corporation of America (VCA) opened a vanadium ore-buying station at Monticello in order to stimulate vanadium mining in the region. Within a short time, ore production increased sufficiently to justify construction of a vanadium mill and, in September 1941, the War Production Board approved the proposal submitted by VCA for mill construction. Funding for construction was provided by the U.S. Government through the Defense Plant Corporation. The Metals Reserve Company assumed operation of the ore-buying station in April 1942, while the VCA operated the mill. The first vanadium was produced at the new mill on 24 August 1942. In 1943, VCA began producing a uranium-vanadium sludge for the Manhattan Engineer District (MED), which had recently initiated a program to obtain domestic uranium. The mill was closed in February 1944.

b. The VCA reopened the mill from 1945 to 1946 under lease from the Defense Plant Corporation and purchased stockpiled ore from the Metals Reserve Company. During this period, the VCA produced a uranium-vanadium sludge which it sold to the Manhattan Engineer District.

c. The Atomic Energy Commission (AEC) bought the Monticello millsite from the War Assets Administration in 1948. The American Smelting and Refining Company (AS&R) acted as the ore-buying agent for the AEC, and The Galigher Company was engaged to design and operate a uranium mill at the site. In 1956, Lucius Pitkin, Inc., replaced AS&R as the ore-buying agent, and April 1956,
the National Lead Company (NLC) assumed operation of the mill. Shortly thereafter, the NLC also took over ore weighing, sampling, and stockpiling activities, while Lucius Pitkin, Inc., continued to conduct administrative activities associated with ore purchase contracts, assaying, and settlements. The mill closed in January 1960, but the ore-buying station remained open until 31 March 1962.

1.7 DESCRIPTION OF MILLING PROCESSES

a. VCA Salt Roast Process

1. During VCA operations at the Monticello mill, a salt roast process was used to convert vanadium mineral to soluble form. However, the high lime content of the carnotite ore processed at the mill presented metallurgic problems.

2. The calcium carbonate caused excessive slagging, and the calcium liberated by roasting formed insoluble vanadium compounds. To counteract these problems, pyrite was added to cause some of the calcium to form calcium sulfate.

3. The hot ore was quenched in a solution of sodium carbonate, at which point most of the vanadium dissolved and calcium remaining as calcium chlorate precipitated as calcium carbonate.

4. After successive washing, the sands were transferred to tailings. Precipitation of vanadium pentoxide (V_2O_5) from the pregnant liquor was induced by the addition of sulfuric acid. The precipitate was washed to remove sodium chloride and sodium sulfate, and the wash water was discharged to the nearby creek.

b. AEC Processes

1. Ores received at the AEC ore-buying station and processed at the mill came from a wide geographic area and had a broad spectrum of metallurgic properties that affected the milling. As many as 27 different ore types were recognized among Colorado Plateau ores, which required a variety of milling processes.

2. Tests on the ores for process amenability were performed by the Monticello plant, at the U.S. Bureau of Mines in Salt Lake City, and by the AEC Pilot Plant in Grand Junction.

3. The milling processes used at Monticello during the 12 years of AEC operation included:

a) Up to 1955 - Raw ore carbonate leach, low-temperature roast/hot carbonate leach, salt roast/hot carbonate leach.

b) From 1955 to 1958 - Acid leach resin-in-pulp (RIP), raw ore carbonate leach.

c) From 1958 to closure in 1960 - Carbonate pressure leach RIP.

1.8 OPERABLE UNITS

a. Due to the complexity of the Monticello Mill Tailings Site, DOE has divided the work into three manageable components called "Operable Units". Operable units are used to differentiate the types of properties or kinds of contaminated materials and to provide a means for developing and evaluating alternatives for remedial action for each operable unit.

1. Operable Unit I - Mill Tailings and Millsite Property

a) Operable Unit I includes the 78 acres of the millsite and the tailings impoundment areas, the tailings removed from the peripheral properties, and the tailings removed from Monticello Vicinity Properties. The tailings piles are within the floodplain of Montezuma Creek. They are also partially in contact with a shallow alluvial aquifer underlying the site. An estimated 100,000 cubic yards of contaminated material have been identified in the mill area; and approximately 1.4 million cubic yards (2 million tons) of tailings, contaminated soil, by-product material, and contaminated building material are located in the tailings impoundment areas.

2. Operable Unit II - Peripheral Properties

a)Peripheral properties include private land to the north and south of the existing site leased for the stockpiling of ore. The former ore-stockpile areas and areas contaminated by airborne tailings or surface water transported materials cover approximately 300 acres around the site and contain most of the estimated 300,000 cubic yards of peripheral property material to be remediated. Peripheral properties also include the bed and banks of a 3.3-mile reach of Montezuma Creek extending from the millsite to the confluence of Montezuma and Vega Creeks.

3. Operable Unit III - Ground Water and Surface Water

a) Operable Unit III includes all of the alluvial aquifer beneath the tailings piles extending approximately one mile down stream. At present, the alluvial aquifer is not used as a private or public drinking water source and is separated from the deeper Burro Canyon aquifer by the Dakota Sandstone. The Burro Canyon aquifer, which is currently being used as a drinking water supply, has not been contaminated. The total water volume that is contaminated is estimated to be approximately 163 acre-feet. An acre-foot of water is equivalent to 325,000 gallons.

b) Operable Unit III surface water consists of Montezuma Creek, which flows through the millsite. It is a small perennial stream with headwaters in the Abajo Mountains immediately west of Monticello.

SECTION 2-ASSIGNMENT OF RESPONSIBILITIES

The Department of Energy (DOE) manages the Grand Junction Projects Office (DOE/GJPO) in Grand Junction, Colorado. Chem-Nuclear Geotech is the operating contractor at the GJPO. Geotech's program manager for MRAP reports to a DOE/GJPO program sponsor. Further details of the program manager/project manager structure at Geotech are found in the Operations Management Policy Manual (Manual 104). A copy of the manual will be in the custody of the Site Health and Safety Coordinator (SHSC) in Monticello. The names and telephone numbers of the following Geotech personnel shall be conspicuously posted on the site and shall be reviewed during pre-activity training.

2.1 PROGRAM MANAGEMENT

a. **Program Manager**, Geotech

1. Has full authority in any matter involving program cost, schedule, personnel, and performance.

2. Performs agency liaison in all matters at MRAP.

b. **Project Manager**, Geotech

1. Responsible for all Geotech activities associated with MRAP remedial action.

2. Approves and issues the HSP and addenda of the HSP for work at MRAP. Directs the implementation of HSP in the field.

3. Directs the production for addenda to the health and safety plan, as necessary, during the progress of the work to adequately address changing conditions and scope. Submits the addenda for approval by the Manager-Health, Safety, and Security (MGR-HS&S).

2.2 HEALTH AND SAFETY

a. **Manager-Health, Safety, and Security Section** (MGR-HS&S), Geotech

1. Provides technical support for the development of the HSP.

2. Provides technical guidance for development of health and safety procedures to be used at the work site.

3. Reviews and approves the HSP submitted by the PM.

4. Agency liaison on matters relating to safety and health at MRAP.

b. Manager Occupational Medical Program (MGR-OMP)

1. Responsible for the administration of the Occupational Medical Program.

2. Acts as interface between the Contract Physician, the Emergency Treatment Facility, and Geotech.

3. Maintains all Geotech employee medical and exposure records.

4. Correlates exposure data to ensure scope of annual "at-risk" physical examinations are correct.

5. Issues letters to Geotech employees relating to exposure to hazardous materials.

7. Provides consulting physician with the following:

a) Copy of 29 CFR 1910.120.
b) Data relating to expected employee exposure levels.
c) Description of PPE to be used on work sites.
d) Description of employee's duties as they relate to the employee's exposure.

c. – Occupational Health and Safety Supervisor (OHS-SUP), Geotech

1. Maintains working file of satisfactory completion of training and medical surveillance for employees and subcontractor employees working at MRAP.

2. Assigns the responsibility of SHSC. The name of the technician assigned this task will be posted at the site.

3. Provides technical guidance for the SHSC and other Operational Health and Safety Technicians (OHST) assigned to work at MRAP.

4. Performs technical review of health and safety documentation and worker exposure monitoring.

5. Provide technical guidance to the PM-MRAP for the content of any addenda.

d. Site Health and Safety Coordinator (SHSC), Geotech

1. Senior OHST on site. Reports to the OHS-SUP. Responsible for the supervision of subordinate OHSTs, when assigned to the site.

2. Ensures implementation of the principles and requirements established in this HSP.

3. Advises the Field Engineer (FE) and Construction Inspector (CI) on all aspects of the site health and safety.

4. Stops work if any operation threatens worker health and safety.

5. Assumes responsibilities listed in Section 2.2.e. when no other OHST is assigned to the site.

6. Facilitates the site-specific training (Section 4.2.b), Hazard Communication training (Section 4.2.c), and weekly "Tailgate" safety training meetings (Section 4.3).

7. Provides and maintains a site copy of 29 CFR 1910.120 and all supporting reference material, including referenced Geotech manuals, and ensures full employee access.

e. Operational Health and Safety Technician (OHST), Geotech

1. Performs and documents all required environmental sampling and worker exposure monitoring as outlined in Section 7.

2. Provides technical guidance to the Construction Inspector for the establishment of:

a) Work boundaries.

b) Levels of PPE Protection.

c) Work/Rest regimes.

3. Performs periodic safety inspections.

2.3 CONSTRUCTION MANAGEMENT (CM)

a. Field Engineer (FE), Geotech

1. Coordinate on-site project activities.

b. Construction Inspector (CI)

1. Act as the direct representative of CM in the field.

2. Provide for site security during normal working hours.

SECTION 3-MEDICAL SURVEILLANCE PROGRAM

3.1 CONSULTING PHYSICIAN

Geotech's company physician is:

G. K. Omura, M.D.
1120 Wellington Avenue
Grand Junction, CO 81501
(303) 241-6011

He has been familiarized with the hazardous materials identified in Section 5 that are suspected as being potential worker exposure hazards during the work at MRAP. He will determine who the consulting physician will be in Monticello and will be the contact for the consulting physician. The consulting physician will also be familiar with the hazardous materials identified in Section 5.

3.2 EMERGENCY TREATMENT FACILITY

a. The Emergency Treatment Facility designated for use in emergency treatment of injuries or illness is:

San Juan Hospital
364 West First North
Monticello, Utah. 84535
(801) 587-2116

b. This facility shall have physicians that are familiar with the hazardous materials identified in Section 5 that are suspected as being potential worker exposure hazards during the work at MRAP. This facility will be used in the event that emergency treatment of a worker is required. Geotech will contact the Emergency Treatment Facilities at San Juan hospital to ensure they are prepared to treat injuries/illness that may occur as a result exposure to the hazards at the site. This includes contaminated injured persons that are evaluated as a medical emergency requiring immediate life-saving medical attention. If required by San Juan Hospital, the SHSC can be transported along with any medical emergency victims to direct decontamination efforts at the emergency treatment facility. Decontamination of injured persons who are not medical emergencies will be conducted by the SHSC prior to transportation to the treatment facility. These procedures are addressed in detail in Geotech's Manual-103, *Environmental, Safety, and Health Procedures Manual.*

c. The back-up facility is:

St. Mary's Hospital and Medical Center
2635 North 7th Street
Grand Junction, CO 81504
(303) 244-2273

Transportation would be accomplished via the hospital's Air Life Helicopter.

d. The SHSC shall ensure that the maps providing the location of San Juan Hospital, including primary and secondary travel routes from the millsite and repository site, shall be posted in a location conspicuous to all workers at the millsite and repository site. These maps are included as Figures 3-1 and 3-2.

3.3 PHYSICAL EXAMINATION

a. Introduction

1. All Geotech personnel on site will, at no cost to themselves, have successfully completed a preplacement or periodic/update physical examination.

2. Subcontractor personnel should meet the medical requirements of 29 CFR 1910.120.

3. The examination requirements listed in this section have been designed to comply with 29 CFR 1910.120 requirements for hazardous waste site operations.

b. Initial Examinations

1. Geotech employees:

a) Completion by the employee of the "Medical and Occupational History Form",(FORM Geotech-1616B).

b) Complete Blood Count with Differential

c) SMAC 23

d) Urinalysis (dipstick and microscopic)

e) Chest X-ray - if Geotech does not have one on file within the past three years.

f) Pulmonary Function Test (FEV/FVC)

g) Audiogram

h) Electrocardiogram

i) Visual Acuity

FIGURE 3–1
HOSPITAL LOCATION AND EMERGENCY ROUTE MAP

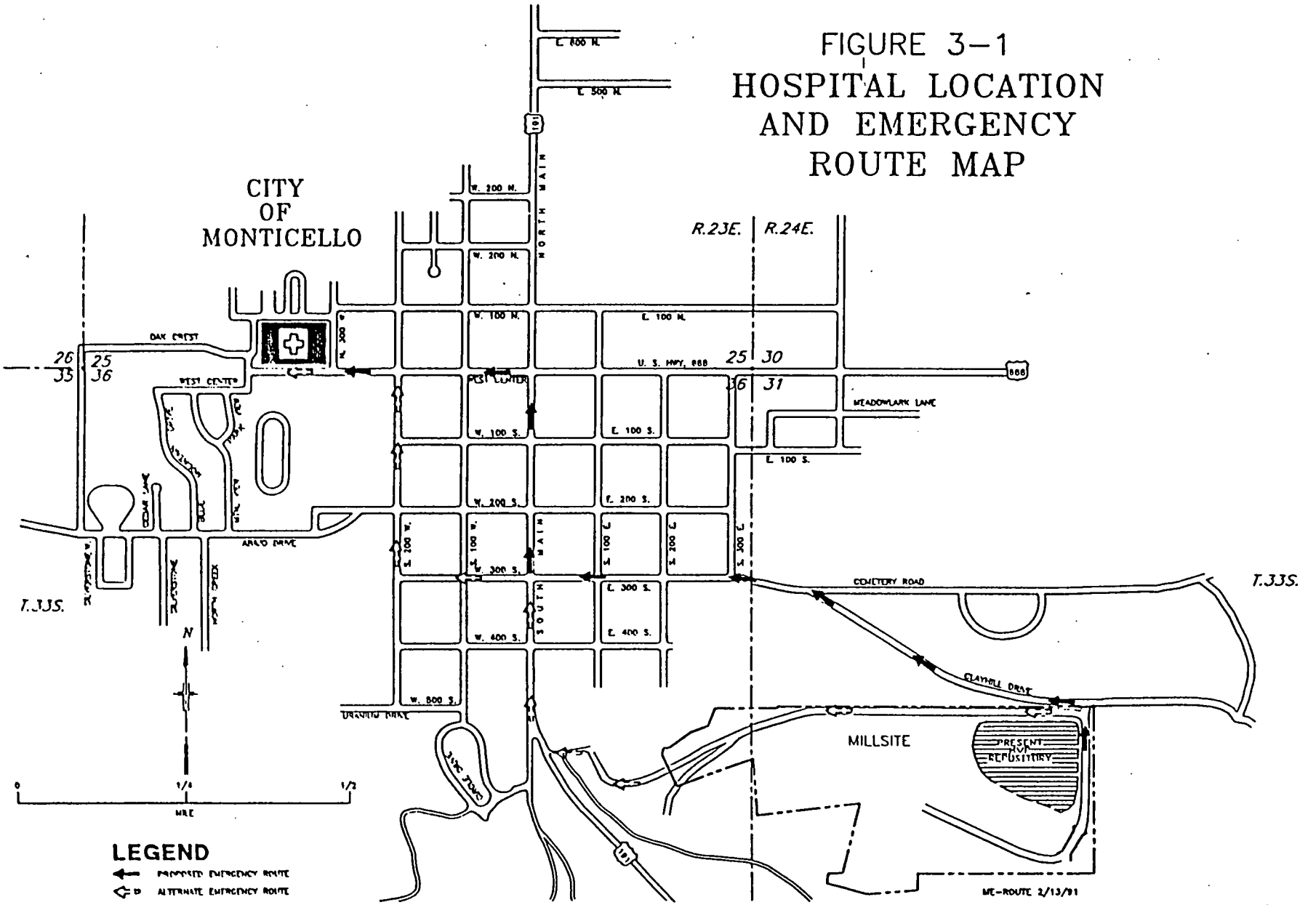
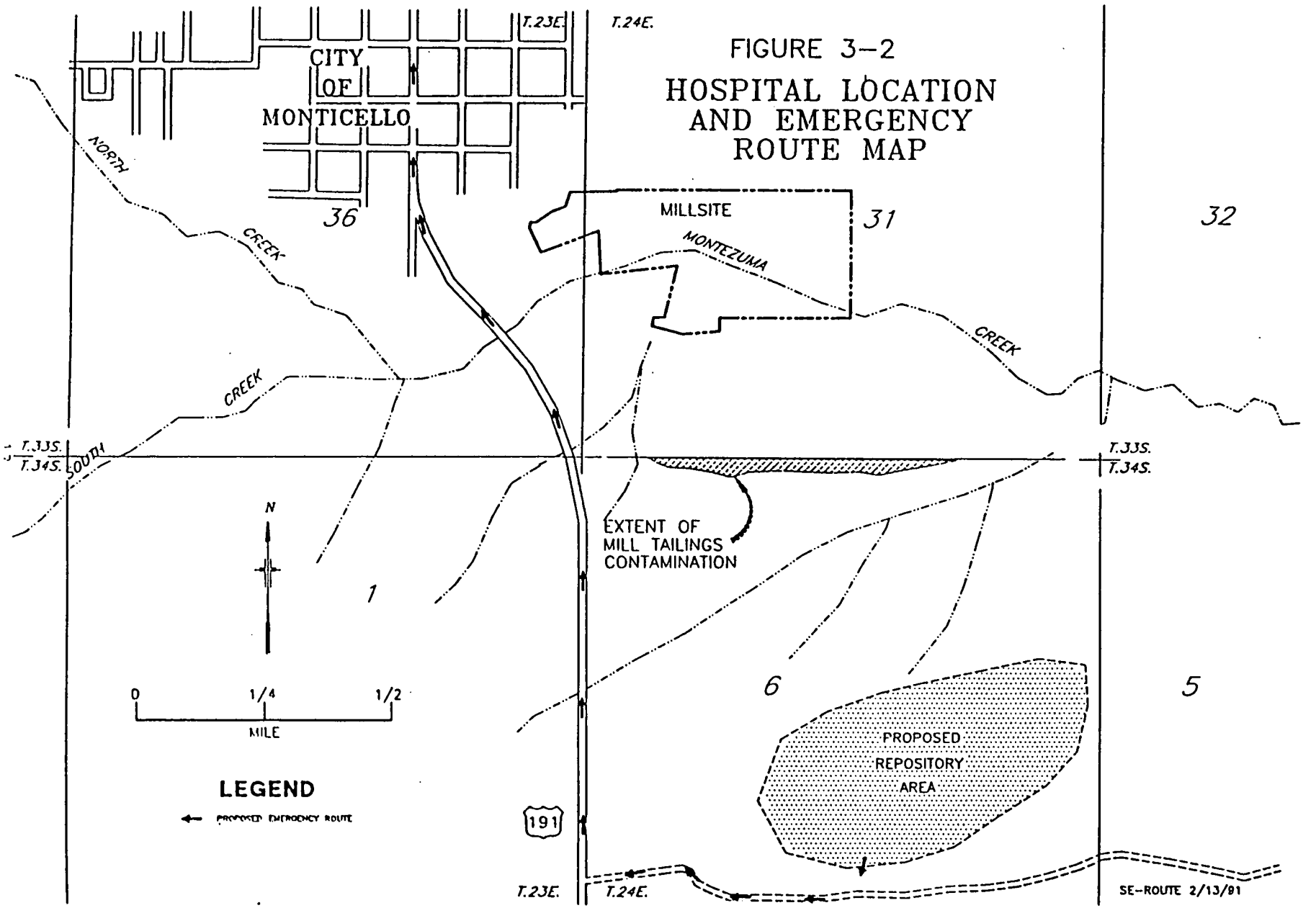


FIGURE 3–2
HOSPITAL LOCATION AND EMERGENCY ROUTE MAP



2. Subcontractor Employees

a) All subcontractor employees who have potential for exposure to hazardous materials should have successfully completed an examination similar to the preplacement physical specified in Section 3.3.b.1.

b) The cost for medical surveillance will be paid by the subcontractor.

c) The physician selected by the subcontractor must provide Geotech a copy of his printed name, license number and the state in which he is licensed to practice.

3. The Physician will provide the subcontractor with a "Physicians Opinion" upon completion of the medical examination. The subcontractor will then, in turn, pass this opinion on to Geotech medical personnel.

c. Injury/Illness re-examinations:

1. Any employee of Geotech will be given another physical examination if:

a) They are suspected of having an overexposure to the hazardous materials on site.

b) They develop a lost-time illness of 5 working days or more.

c) They sustain any lost-time injury.

2. Geotech employees located in Monticello, Utah, will see the consulting physician discussed in Section 3.1, as directed by Dr. Omura, Geotech's Contract physician.

3. Subcontractor employees will be seen by the subcontractor's physician, at the subcontractor's expense. Subcontractors will notify Geotech within 24 hours of any work related injury or illness.

4. If an injury/illness is the result of a hazardous material exposure, the SHSC shall promptly notify the Consulting Physician and/or Treating Physician of the material identified as that which caused the exposure.

a) Material identification may be accomplished through use of:

i) Real Time monitoring equipment (photoionization detectors in conjunction with detector tubes).

ii) Conventional industrial hygiene monitoring (lapel air sampling, dermal exposure patch, etc.).

iii) Any prior sampling results available.

5. The scope of the re-examination requirements will be specified by the MGR-OMP and the Consulting Physician.

6. The physician will complete a "Physician's Recommendation for Return to Work" (FORM Geotech-1574) after completion of the re-examination of each employee to certify that he/she is fit to return to work, and if necessary, specify any activity restrictions to be followed.

7. Specific emergency response procedures to be followed in the event of an injury or illness occurrence on the site are cover in Section 11 of this HSP.

8. Requirements for reporting Off-Normal Events are specified in Reference 5, Appendix C.

d. Termination

1. All personnel must complete a physical examination upon termination.

3.4 MEDICAL RECORDS

a. Geotech and subcontractor medical and personnel exposure monitoring records will be maintained in accordance with the requirements of 29 CFR 1910.120 and will be kept for a minimum of 30 years after termination. Employee confidentiality will be maintained.

b. Employees will be notified on an annual basis of the following:

1. Status/results of medical examinations
2. Right to access those records at any time.
3. Where and how to access medical records.

SECTION 4-TRAINING PROGRAM

4.1 INTRODUCTION

a. This training program is designed to address the requirements of:

1. OSHA Hazardous Waste Operations and Emergency Response Standard 29 CFR 1910.120.

2. OSHA Hazard Communication Standard 29 CFR 1910.1200.

3. All reciprocal UOSHA regulations apply for cited OSHA regulations.

b. Each employee, supervisor, subcontractor employee and subcontractor supervisor working on the site exposed to hazardous substances, health hazards, or safety hazards will receive training that meets the requirements of this section.

c. No person required to be trained by Section 4.1.b. will participate in or supervise hazardous waste operations that could expose them to hazardous substances, health hazards, or safety hazards associated with the site prior to documented completion of all training requirements in this section.

d. The requirements of this document and all addenda will be disseminated to personnel working on site through formal training sessions. Individuals who receive this training will be required to provide signature verification that they have read, understand, and will comply with all requirements stated within this document (see Section 8.4).

e. Site visitors will be exempt from the provisions of this section but will be required to attend a safety briefing which contains applicable sections of site-specific employee training (see Section 9.4).

f. Training course descriptions for all training provided to Geotech employees are addressed in Manual-103, *Environmental, Safety, and Health Procedures Manual*. Controlled copies of all reference material is maintained with the MRAP Program HSP in the possession of the SHSC and can be made available as necessary.

4.2 PRE-PROJECT TRAINING

a. Off-site training:

1. All employees and contractors who work on site shall have successfully completed a formal training program that will include a minimum of 40 hours of initial off-site instruction, and a minimum of three days actual field experience under instruction with a trained, experienced supervisor, unless they meet the following criteria:

a) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying or geophysical surveying), and who are unlikely to be exposed over permissible exposure limits and published exposure limits, shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained experienced supervisor.

b) Workers regularly on site who work in areas which have been monitored and fully characterized as being clean (indicating that exposures are under permissible or published limits, respirators are not necessary, and there are no health hazards or the possibly of an emergency developing) shall receive a minimum of 24 hours of instruction off the site and one day actual field experience under the direct supervision of an experienced supervisor.

c) Workers with 24 hours of training who are covered by paragraphs a and b of this section and who become general site workers or who are required to wear respirators shall have the additional 16 hours and two days of training necessary to total the training specified for all employees.

d) Activities conducted on the new repository site (except for sloped hillside areas) prior to the hauling of mill tailings will be considered not applicable to OSHA 29 CFR 1910 requirements because of geographic separation from the millsite, and the existence of no contamination (see Figure 3-2 for location map).

2. On-site management and supervisors directly responsible for employees engaged in hazardous waste site operations shall complete at least 8 additional hours of specialized training on managing such hazardous waste site operations at the time of job assignment.

3. Workers who are exposed to unique or special hazards shall be provided additional training. The level of training provided shall be consistent with the employee's job function and responsibilities.

4. The standard Red Cross First Aid and Cardiopulmonary Resuscitation (CPR) training is required for all OHSTs assigned to the site.

5. All employees will be current in the training listed in numbers 1) through 4) above as applicable by meeting the specific periodic refresher requirements.

b. Site specific training:

1. This training will be coordinated by the CI, or a designated alternate. This HSP will provide the basis for this training and all aspects will be addressed.

2. The content of the training will include but not be limited to:

a) Names of personnel and alternates responsible for site health and safety.

b) Safety, health, and other hazards present on the site as discussed in Section 5 of this HSP.

c) The proper use of PPE as discussed in Section 6 of this HSP.

d) The approved SOPs and Emergency Response Actions contained in Sections 8 and 10 of this HSP.

e) The safe use of engineering controls and equipment on the site.

f) The Medical Surveillance Program contained in Section 3 of this HSP.

g) Site access controls, methods of postings of controlled areas.

h) Requirements for confined space entries.

c. Radiation Worker Training

1. Geotech Manual-103, *Environmental, Safety, and Health Procedures Manual*, ES&H Procedure 9.2 implements the Radiation Safety Courses for Geotech. This procedure meets the requirements of DOE 5480.11 for initial radiation worker qualification. This procedures also meets the requirements for annual radiation worker refresher qualification.

d. Hazard Communication Training

1. This training will be coordinated by the CI, or a designated alternate, with support from the SHSC. This HSP will provide the basis for this training and all aspects will be addressed.

2. The content of the training will include but not be limited to:

a) Requirements of 29 CFR 1910.120 pertaining to employee information and training.

b) Operations in the work area where hazardous chemicals and physical agents are present.

c) The location and availability of the written hazard communication program and MSDS sheets.

d) The methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area.

e) The health hazards of the chemicals and physical agents in the work area.

f) Measures workers can take to protect themselves.

g) Information on the labeling system used to identify hazardous materials by the employer.

h) The hearing conservation program.

i) The respiratory protection program.

j) Labeling of hazardous material containers.

4.3 TAILGATE SAFETY MEETINGS

a. Weekly "tailgate" Safety meetings will be conducted for Geotech employees by the SHSC or a designated alternate.

b. The discussion at these meetings will include:

1. The health and safety considerations and necessary protective equipment for the current operations.

2. Any addenda to the HSP.

3. Any new MSDS filed on site.

4. All documented and/or observed unsafe acts committed on the site since the previous meeting and methods to prevent recurrence.

c. Each employee present will sign a training form to document that the employee understands the information discussed and agrees to abide by any requirements set down.

4.4 TRAINING RECORDS

a. All training that is conducted by or for Geotech will be documented on Form Geotech-1720 "Training Attendance Sheet".

b. Successful completion of the Geotech facilitated training specified in Section 4.2 b. and c. is required for all employees and subcontractor employees prior to the commencement of work on the site by that employee.

c. Documentation of the training requirements specified in Section 4 will be required prior to an employee being given access to the site. Copies of the completion certificates must be submitted to the OHS-SUP to meet satisfactory documentation requirements.

d. Retention of all training records for archive will be performed at the GJPO, by training and employee development. Copies will be maintained in the OHS project file.

SECTION 5-HEALTH AND SAFETY HAZARD ANALYSIS

5.1 POTENTIAL CONTAMINANTS

a. The following hazardous and radioactive materials have been identified as possible contaminants at the Monticello Remedial Action Project.

1. Surface contamination of uranium & uranium decay daughters.
2. Possible chlorinated hydrocarbons (PCBs, pesticides)
3. Inorganic substances
4. Asbestos
5. Caustic/acidic areas
6. Airborne silica

b. -A list of potential on-site contaminants and their respective limits in air for personal exposure is found in Table 5-1.

Table 5-1

Contaminant	OSHA Permissible Exposure Limit TWA
Antimony	0.50 mg/m3
Arsenic	0.01 mg/m3
Asbestos	0.20 fibers/cc
Beryllium	0.20 ug/m3
Cadmium	0.20 mg/m3
Chlorodiphenyl (PCBs)	0.50 mg/m3
Chromium	0.50 mg/m3
Copper	1.00 mg/m3
Lead	0.05 mg/m3
Mercury	0.10 mg/m3 ceiling limit
Molybdenum	5.00 mg/m3
Nickel	1.00 mg/m3
Selenium	0.20 mg/m3
Silver	0.01 mg/m3
Thallium	0.10 mg/m3
Th-230	2.0x10-12uCi/cc[a]
U-238	7.0x10-5uCi/cc[a]
Ra-226	8.0x10-12uCi/cc[a]
Vanadium	0.05 mg/m3
Zinc	5.00 mg/m3

[a]DOE 5480.11 "Radiation Protection For Occupational Workers"

"Permissible Exposure Limits" may change dramatically when combinations of contaminants occur simultaneously.

5.2 HEAT STRESS

a. Heat stress will be of concern during periods of warmer ambient temperature.

b. The level of PPE required for the task along with the following factors affect individuals' susceptibility to heat stress:

1. Level of physical fitness
2. Acclimatization to environment
3. Age
4. Dehydration and/or diarrhea
5. Obesity
6. Alcohol or drug use
7. Infection
8. Sunburn

c. Prevention Methods

1. The criteria established as the Threshold Limit Values (TLV) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for heat stress, will be followed to provide adequate cooling down of workers.

2. One or more of the following control measures can be used to help control heat stress:

a) Establishment of a work/rest regimen that will provide adequate rest periods for cooling down. This may require additional shifts for workers or earlier/later work schedules.

b) All breaks are to be taken in a shaded rest area.

c) Adequate liquids will be provided to replace lost body fluids to ensure that the cardiovascular system functions properly. The thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost sweat. Water intake should correspond to current environmental conditions and level of PPE.

d) Replacement fluids can be fresh water or an electrolyte solution, such as Gatorade or Quick Kick, or a combination of these. Salt tablets will <u>not</u> be used.

e) Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments provided the employee is properly trained to its use.

f) Employees shall remove impermeable protective garments during rest periods. Disposition of these garments will be at the discretion of the OHS technician.

g) Employees shall not be assigned other tasks during rest periods.

h) All employees shall be informed of the signs and symptoms of heat stress along with the importance of adequate rest, acclimatization, and proper diet in its prevention.

d. Signs and Symptoms of Heat Stress

1. Heat rash may result from continuous exposure to heat or humid air.

2. Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

a) Muscle spasms
b) Pain in the hands, feet, and abdomen

3. Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

a) Pale, cool, moist skin
b) Heavy sweating
c) Dizziness
d) Nausea
e) Fainting

4. Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained immediately. Signs and symptoms are:

a) Red, hot, usually dry skin
b) Lack of or reduced perspiration
c) Nausea
d) Dizziness and confusion
e) Strong, rapid pulse
f) Coma

e. First Aid

1. Controlled copies of the American Red Cross Standard First Aid will be are maintained with the MRAP Program HSP, in the possession of SHSC at the millsite, and will be made available as necessary for heat emergencies.

5.3 HYPOTHERMIA

a. Hypothermia will be of concern depending upon ambient temperature.

b. The following heat loss pathways are factors that can contribute to the amount of injury sustained in the cold environment:

1. Radiation - up to 25% of the heat loss sustained in a cold environment can be attributed to radiation from exposed flesh.

2. Conduction - bare skin contact with cold objects: ladders, metal surfaces, wet clothing, snow, ice, or water all result in a rapid loss of heat in the localized effected area.

3. Convection - best described by the "WIND CHILL INDEX", the movement of air can be the greatest and most deceptive factor of worker body heat loss.

4. Evaporation - the body's natural cooling mechanism presents a compounding effect on a conductive environment.

c. Prevention Methods

1. The criteria established as the TLV, recommended by the ACGIH for cold stress, will be followed to maintain workers, deep body core temperature.

a) The work/warm-up schedule recommended by the ACGIH will be used to provide adequate periods for re-warming.

b) Provisions for additional full body protection is required if work is performed in temperatures at or below $4^{o}C$.

c) Warning to the workers and special protection (mittens) for the hands may be required to prevent contact frostbite during periods that cold surface temperatures fall below $-7^{o}C$.

d) For exposed skin, continuous exposure should not be permitted for an equivalent chill temperature of $-32^{o}C$.

d. Unless there are unusual or extenuating circumstances cold injury to other than hands, feet, and head is not likely to occur without the initial signs of hypothermia. Utilize Table 5-2 as a guide to evaluating worker hypothermia symptoms.

e. First Aid

1. Controlled copies of the American Red Cross Standard First Aid will be maintained with the MRAP Program HSP, in the possession of SHSC at the millsite, and will be made available as necessary for cold emergencies.

5.4 NOISE

a. Geotech will follow the guidelines specified in 29 CFR 1910.95 for the Hearing Conservation Program.

1. Excessive noise levels may be generated from drilling rigs, air compressors, electrical generators, and heavy construction equipment.

2. Hearing protection will be worn by all employees working in noise levels of 85dB(A) or greater.

3. All training and implementation of the requirements in this section will be in accordance with the pending Geotech Hearing Conservation Program.

5.5 OTHER PHYSICAL HAZARDS

a. The following physical hazards have been identified for MRAP. Additional physical hazards will be identified in the site-specific HSPs.

1. Underground utilities, buried tanks, natural gas/hazardous substance pipelines.

2. Overhead power lines, energized electrical systems.

3. Pressurized equipment

4. Grade of the terrain

5. Biological hazards including snakes, ticks, other insects, and poisonous plants in the vegetation.

6. Heavy equipment, e.g. backhoe, drill rig etc..

7. Hot work.

b. Controls associated with the above physical hazards will be in accordance with approved Geotech procedures (see Manual-103, *Environmental, Safety, and Health Procedures*) and UOSHA requirements.

Table 5-2. Progressive Clinical Presentation of Hypothermia[a]

Core Temp. °C	Core Temp. °F	Clinical Signs
37.6	99.6	"Normal" rectal temperature
37	98.6	"Normal" oral temperature
36	96.8	Metabolic rate increases attempting to compensate for heat loss
35	95.0	Maximum shivering
34	93.2	Victim conscious and responsive, with normal blood pressure
33	91.4	Severe hypothermia below this temperature
32 31	89.6 87.8	-- Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated but react to light; shivering ceases
30 29	86.0 84.2	-- Progressive loss of consciousness; muscular rigidity increases, pulse and blood pressure become difficult to obtain; pupils dilated but react to light; respiratory rate increase
30	82.4	Ventricular fibrillation possible with myocardial irritability
27	80.6	Voluntary motion ceases, pupils nonreactive to light, deep tendon and superficial reflexes absent
26	78.8	Victim seldom conscious
25	77.0	Ventricular fibrillation may occur spontaneously
24	75.2	Pulmonary edema
22 21	71.6 69.8	-- Maximum risk of ventricular fibrillation
20	68.0	Cardiac standstill
18	64.4	Lowest accidental hypothermia victim to recover
17	62.6	Isoelectric electroencephalogram
9	48.2	Lowest artificially cooled hypothermia patient to recover

[a] American Family Physician, Jan. 1982. Published by the American Academy of Family Physicians.

SECTION 6 - PERSONAL PROTECTIVE EQUIPMENT

6.1 INTRODUCTION

a. The following discussions relate to programmatic requirements for Personal Protection Equipment (PPE). Additional requirements may need to be established based on specific tasks. These requirements will be addressed in site-specific HSPs:

1. Guidance for the ensemble content listed is taken from References 1 and 3, Appendix C.

2. Protection Factors for the use of the respiratory protection equipment used in these ensembles is based on References 2 and 4, Appendix C.

3. Evaluation for changing the PPE level specification is required throughout the work.

4. Personnel monitoring must be performed during the initial performance period of each specific task type. This will ensure that the level of protection selected is appropriate for the worker breathing zone concentrations and dermal exposure levels measured.

6.2 PROTECTIVE EQUIPMENT ENSEMBLES

a. LEVEL B required protection consists of the following ensemble:

1. Full face supplied air respirator approved by the Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH). Respirators can be:

a) Pressure demand, self-contained breathing apparatus.

b) Pressure demand, air line respirator.

2. Chemical-resistant clothing (coveralls and long sleeved jacket; hooded, one or two piece chemical splash suit; disposable chemical-resistant, one-piece suit).

3. Long cotton underwear

4. Gloves (outer), chemical-resistant.

5. Gloves (inner), chemical-resistant.

6. Boots (outer), chemical-resistant, steel toe and shank.

7. Boots covers (outer), chemical-resistant (disposable).

8. Hard Hat (face shield).

9. Two way radio communication.

b. LEVEL C required protection consists of the following ensemble:

1. Air-purifying respirator, full-face, canister equipped (MSHA or NIOSH approved).

2. Chemical-resistant clothing (coveralls; hooded, one or two piece chemical splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls).

3. Coveralls.

4. Long cotton underwear.

5. Gloves (outer), chemical-resistant.

6. Gloves (inner), chemical-resistant.

7. Boots (outer), chemical-resistant, steel toe and shank.

8. Boots covers (outer), chemical-resistant (disposable).

9. Hard Hat (face shield).

10. Two way radio communication.

c. MODIFIED LEVEL D required protection consists of the following ensemble:

1. Chemical-resistant clothing (coveralls; hooded, one or two piece chemical splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls).

2. Coveralls.

3. Long cotton underwear.

4. Gloves (outer), chemical-resistant.

5. Gloves (inner), chemical-resistant.

6. Boots (outer), chemical-resistant, steel toe and shank.

7. Boots covers (outer), chemical-resistant (disposable).

8. Hard Hat (face shield).

9. Two way radio communication.

d. LEVEL D required protection consists of the following ensemble:

1. Coveralls, or sturdy work pants and sleeved shirt.

2. Gloves.

3. Boots (outer), leather or chemical-resistant, steel toe and shank.

4. Safety glasses or chemical splash goggles.

5. Hard Hat (face shield).

6.3 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

a. Site Hazards

1. Refer to Section 5 of this document for Site Hazards.

2. MRAP project is scheduled until October 1994.

b.- PPE Selection and Use

1. PPE shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterizations and analysis.

2. PPE selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and durations, and the hazards and the potential hazards identified at the site.

3. Positive pressure self-contained breathing apparatus, or positive pressure air line respirators equipped with an escape air supply shall be used in IDLH conditions.

4. The level of protection provided by PPE selection shall be increased when additional information or site conditions show that increased protection is necessary to reduce employee exposures below established permissible exposure limits for hazardous substances and health hazards.

5. The level of protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

6. The level of protection deemed necessary by the SHSC or OHS Technician will correlate with those ensembles set forth in Section 6.2 of this procedure.

c. Maintenance and Storage

1. All PPE will be maintained by OHS Technicians and stored in an appropriate manner at a location to be determined.

d. PPE Decontamination

1. PPE decontamination will not occur routinely in favor of proper disposal of disposable whites. In the event PPE decontamination is required, addenda to this plan approved by the manager of OHS will be issued to address the procedure.

e. Training and Proper Fit

1. Prior to PPE issue, all Geotech employees and subcontractors will be subjected to a training session addressing major points and concerns.

2. This training will be given by OHS Technicians and properly documented on a Geotech Training Form as to attendance and content.

3. OHS Technicians will ensure all PPE issued is of the proper size and fit for the employee to ensure maximum efficiency.

f. Donning and Doffing Procedures

1. When PPE is required, donning and doffing procedures will be provided by the SHSC. The on-site OHS Technicians will be responsible for ensuring all employees adhere to these posted procedures.

g. Inspection

1. PPE will be inspected immediately prior to use to verify integrity of all surfaces and seams.

2. PPE in storage will be routinely inspected to ensure quality at an interval to be determined by OHS Technicians based on storage and surrounding conditions.

h. In-Use Monitoring

1. During PPE use, OHS Technicians will monitor for rips, tears, etc. in the PPE at intervals as he/she deems necessary based on site activities.

2. Any discovering of a breech in the integrity of PPE shall be corrected as soon as possible and the event documented on a Health and Safety Checklist Form.

i. Program Effectiveness

1. Evaluation of PPE effectiveness shall be performed by a staff Industrial Hygienist when requested by the OHS supervisor.

j. Temperature Extremes (see Section 7 of this document)

6.4 GUIDELINES FOR RESPIRATOR USE

a. Respirator use will be in accordance with the Geotech Respirator Program.

b. Until accurate breathing zone exposure data is established, respiratory protection will be required.

c. During initial work in areas suspected to be contaminated with suspected or known carcinogens the lowest level of respiratory protection required within the Exclusion Zone and Decontamination Corridor will be Level C.

d. The following standard procedures need to be understood by all on-site personnel:

1) The respiratory protection utilized on site will be in compliance with OSHA, 1910.134 and Reference 4, Appendix C.

2) Only properly cleaned, maintained, NIOSH/MSHA-approved respirators shall be used on site.

3) When air-purifying cartridges are specified for use, they shall be replaced when loadup or breakthrough occurs, or at least at the end of each shift.

4) Only employees who have training, medical verification, pre-issue fit tests, and annual fit tests thereafter, will be allowed to work in atmospheres where respirators are required. Fit test documentation will be kept as part of each employee's training documentation records.

5) If an employee has demonstrated difficulty in breathing during the fit testing or during use, he or she shall not be allowed to wear a respirator until a medical examination can be conducted to re-verify medical acceptability.

6) No employee shall be assigned to tasks requiring the use of respirators if, based upon the most recent examination, a physician determines that the employee will be unable to function normally wearing a respirator or that the safety or health of the employee or other employees will be impaired by use of a respirator.

7) Regular eyeglasses and contact lenses are not to be worn while wearing a respirator. Only approved respirator eyeglasses will be allowed.

8) Air-supplied respirators shall be assembled according to manufacturer's specifications regarding hose length, couplings, valves, regulators, manifolds, etc. and use certified grade D or better air.

9) All personnel wearing respirators will be required to be clean shaven prior to each day's shift.

6.5 GUIDELINES FOR HEARING PROTECTION USE

a. Hearing protection will be worn by all employees working in noise levels of 85dB(A) 8 hour TWA or greater.

b. Selection of hearing protection devices should provide a sufficient noise reduction ratio to lower worker exposure to below 85dB(A).

c. All employees wearing hearing protection will be trained on its use and limitations.

d. All training and implementation of the requirements in this Section will be in accordance with the pending Geotech Hearing Conservation Program.

e. Engineering or administrative controls will be considered to preclude the need for wearing hearing protection.

SECTION 7- MONITORING

7.1 AREA MONITORING

a. Monitoring for airborne radioparticulates, silica, and heavy metals will be conducted using an MSA Flowlite pump and filter assemblies appropriate for the sampling being performed. Area monitoring for explosive limits, oxygen, and volatile organic compounds will be conducted with "real time" direct-reading instruments and charcoal tubes.

b. The methods of maintenance and calibration for the sampling equipment used is located in the Geotech ES&H Desk Top Procedure which will be kept by the SHSC with other Geotech reference materials.

7.2 PERSONNEL EXPOSURE MONITORING

a. Introduction

1. Personnel exposure monitoring will be conducted during activities in all contaminated areas until sufficient data has been collected to characterize the worker breathing zone exposure.

2. Monitoring shall be further conducted when, in the judgment of the SHSC, an activity or the climate will change the results of the previous characterization work completed.

3. All personnel exposure monitoring records will be maintained for a minimum period of 30 years after termination.

b. Tracking Representative Exposure Monitoring Results

1. Documentation of exposure during "representative" exposure monitoring of Geotech and subcontractor employee exposure will be performed on Geotech Form 1733," Hazardous Materials Access Log".

c. Radiological Monitoring

1. The monitoring of personnel for radiological contamination will be performed at the access/frisking station of the controlled area. All personnel will be required to frisk themselves for contamination prior to exiting the controlled area.

2. Equipment surveys will be conducted prior to the equipment leaving the controlled area, and will be documented on Geotech Form 1553. All equipment will be decontaminated to as low as reasonably achievable levels (ALARA). Only a HS&S technician can release equipment from a controlled area.

3. At least 20% of the work force will be monitored for airborne contamination using lapel samplers. Those employees likely to have the highest potential exposure to those hazardous substances and health hazards most likely to be present above established permissible exposure limits will be those chosen for monitoring.

a) When sufficient data is gathered to allow estimation of exposure levels for frequently performed tasks, sampling will be reduce to monitoring 10% of the work force. Those employees likely to have the highest potential exposure to those hazardous substances and health hazards most likely to be present above established permissible exposure limits will be those chosen for monitoring.

4. The methods of maintenance and calibration for the sampling equipment used is located in the Geotech ES&H Desk Top Procedure kept by the SHSC.

5. Bioassay will be collected for internal intake of radionuclides, if deemed necessary according to the Geotech Internal Dosimetry Program. The bioassay program components are contained in Appendix A.

6. Personnel radiation exposure will be monitored through the use of assigned thermoluminescent dosimeters (TLDs). Upon exiting the access/ frisking station at the end of the scheduled work day, all TLDs will be surrendered and stored overnight in a designated wooden box containing the controlled TLDs.

d. Monitoring for Heat Stress

1. Permeable PPE In Use

a) The heat stress of employees on site will be monitored by the Wet Bulb Globe Temperature Index (WBGT) technique. This method will require area monitoring using a heat stress monitoring device, such as the WBGT Heat Stress Monitor (Reuter Stokes).

b) The WBGT will be compared to the TLVs recommended by the ACGIH. A work/rest regimen will then be established in accordance with ACGIH/ NIOSH guidelines. This regimen and the base guideline will be available on site through the SHSC.

c) The methods of maintenance and calibration for the WBGT used is located in the Geotech OH&S Desktop Procedure Manual kept by the SHSC.

2. Non-Permeable PPE In Use

a) For workers wearing non-permeable PPE, the ACGIH TLVs can not be used. During these situations monitoring will begin when ambient temperature in the work area exceeds $70^{o}F$.

b) Frequency of monitoring depends on air temperature adjusted for solar radiation and the level of work load outlined on Table 7-1.

c) Heart Rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

i) If the heart rate exceeds 110 beats/min. at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.

ii) If the heart rate still exceeds 110 beats/min. at the next rest period, obtain medical attention.

d) Oral temperature. Using a clinical thermometer (3 minutes under the tongue) or a similar device to measure the oral temperature at the end of the work period (before drinking).

i) If oral temperature exceeds 99.6°F(37.6°C), shorten the next work cycle by one-third without changing the rest period.

ii) If the oral temperature exceeds 99.6°F(37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.

CAUTION: DO NOT permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F.

e) Body Water Loss can be used to determine proper intake of fluids and may be a consideration.

f) The methods of maintenance and calibration for the sampling equipment used is located in Reference 4, Appendix C.

TABLE 7-1

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

ADJUSTED TEMPERATURE[b]	NORMAL WORK ENSEMBLE[c]	IMPERMEABLE ENSEMBLE
90°F or Above	After each 45 mins of work	After each 15 mins of work
87.5°- 90°F	After each 60 mins of work	After each 30 mins of work
82.5°- 87.5°F	After each 90 mins of work	After each 60 mins of work
77.5°- 82.5°F	After each 120 mins of work	After each 90 mins of work
72.5°- 77.5°F	After each 150 mins of work	After each 120 mins of work

[a] For work levels of 250 kilocalories/hour

[b] Calculate the adjusted air temperature (ta adj) by using this following equation and guidelines: ta adj °F = ta °F + (13 x % SUNSHINE). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate the % SUNSHINE by judging the percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100% SUNSHINE = no cloud cover and a sharp, distinct shadow; 0% SUNSHINE = no shadows)

[c] Normal work ensemble consists of cotton overalls or other cotton clothing with long sleeves and pants.

e. Monitoring and Control Program for Cold Stress

1. The control program to be used for MRAP will include:

a) Medical supervision of the workers performed during the pre-placement or "at-risk" physical examination.

b) Employee orientation and training on cold stress, cold-induced illness and their symptoms, water and salt replacement, proper clothing, and emergency first aid procedures.

c) Work/rest regimes with heated rest areas and enforced rest breaks.

d) Scheduled drink breaks for recommended fluids.

e) Environmental monitoring using the air temperature and wind speed indices to determine wind chill and adjustment of work/rest schedules accordingly.

f) Reduction of cold stress through the proper use of personal protective equipment, administrative controls, and engineering controls when available.

f. Monitoring Noise Sources

1. Geotech Manual 103, "Environmental, Safety, and Health Procedures" Section 8.5, provides guidance for administration of a hearing conservation program to prevent occupational hearing loss.

2. The requirements of Geotech Manual 103, Section 8.5, will be followed during all phases of MRAP work.

3. Hearing protection will be worn by all employees working in noise levels of 85dB(A) 8 hour TWA or greater.

4. All training and implementation of the requirements in this section will be in accordance with the pending Geotech Hearing Conservation Program.

SECTION 8 - STANDARD OPERATING PROCEDURES

8.1 USE OF GEOTECH MANUAL 103 and ES&H DESKTOP PROCEDURE

a. Geotech Manual 103, "Environmental, Safety, and Health Procedures", and ES&H Desktop Procedures will be used as the source document for all of the Standard Operation Procedures during work at Monticello Remedial Action Project. These references will be in the custody of the SHSC at the millsite.

8.2 ENGINEERING CONTROLS AND WORK PRACTICES

a. Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits of substances regulated by OSHA 29 CFR 1910.120 except to the extent that such controls and practices are not feasible.

b. Engineering controls which may be feasible are the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material-handling equipment. Work practices which may be feasible are removing all nonessential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

c. Whenever engineering controls and work practices are not feasible, PPE shall be used to reduce and maintain exposures to or below the permissible exposure limits of substances regulated by OSHA 29 CFR 1910.120.

d. The employees shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits.

e. An appropriate combination of engineering controls, work practices and personal protective equipment shall be established to reduce and maintain employee exposure to or below the established permissible exposure limit for hazardous substances and health hazards not regulated by OSHA 29 CFR 1910.120.

8.3 GENERAL SANITATION

a. The subcontractor should provide or make arrangements for adequate toilet and handwashing facilities.

b. A suitable source of drinking water shall also be made available.

c. Break/eating areas will be at the discretion of the subcontractor with concurrence of the SHSC.

8.4 PROCEDURE FOR REVIEW/APPROVAL OF SUBCONTRACTOR HSPs

a. Appendix B has been added to the MRAP Program HSP to provide an attribute check list for the review of subcontractor HSP. The subcontractor acknowledgement of HSP information follows.

Subcontractor HSP Information

List each subcontractor working on the site. Date and initial the completion of required actions:

_____ Subcontractor Name	Project Manager Signature	Date
Provided Geotech MRAP Health and Safety Plan	_____	_____
Provided the Geotech site-specific HSP	_____	_____
Received contractors Health and Safety Plan	_____	_____
Reviewed/Approved contractor's SHSC qualifications	_____	_____

SECTION 9- SITE CONTROL

9.1 ESTABLISHMENT OF WORK ZONES

a. Definitions

1. CONTROLLED AREA - any area for which access is managed to protect individuals from exposure to radiation or radioactive materials is classified as a controlled area. The defining criteria for a controlled area is established in the Geotech Environmental, Safety and Health Procedure, Manual 103, Section 3.3.

2. EXCLUSION ZONE - work area where contamination does or could occur. Access is on a "need to" basis only and requires full compliance with all training specifications. Exclusion Zone boundary is determined by the site OHS technician in conjunction with the Field Engineer.

3. CONTAMINATION REDUCTION ZONE - Area where workers should not be exposed to hazardous conditions. All decontamination of personnel and equipment will be performed in this area. Access will be controlled and restricted area will be designated by the on site OHS technician in conjunction with the Field Engineer.

4. BUFFER ZONE - All clear areas outside of Contamination Reduction Zone. Access controlled by the OHS technician.

b. Placement of boundaries

1. Boundary areas will be made of construction security fencing, snow fencing, or barrier ribbon depending upon the terrain, time frame of work, and ease of accessibility to the area.

2. Access point will be established by the HS&S Technician to monitor the flow of personnel and equipment into and out of the work area.

9.2 POSTING

a. The boundary at a CONTROLLED AREA or CONTAMINATION REDUCTION ZONE will be marked with signs stating, "AUTHORIZED PERSONNEL ONLY, NO EATING, DRINKING, SMOKING, OR CHEWING.

b. The Contamination Reduction Zones and the Access Control Points will be posted with signs designating them as such.

9.3 SITE SECURITY

a. Physical barriers will be erected as necessary to:

1. Prevent the exposure of unauthorized, unprotected people to the hazards on the site.

2. Avoid an increase in hazards from vandals or other persons seeking to dispose of additional waste on the site.

3. Prevent the theft of government property.

4. Avoid interference with safe working procedures.

9.4 VISITORS

a. The term "Visitor" as used in this section cannot be applied to any Geotech employee. Examples of a visitor are Geotech clients, Federal/State Regulatory Officials, Chem-Nuclear Environmental Services or Chem-Waste Management corporate employees.

b. All untrained visitors shall receive the visitor-applicable sections of the site specific training. The completion of this training does not allow the visitor into the controlled areas of the site. This training does provide an understanding of the hazards and control measures at the site and does not allow the untrained visitor access into the restricted areas at the site. This training will prevent the visitor from violating any controls unknowingly.

c. The following sections of the project site-specific training may be omitted from the visitor briefing:

- Proper Use of PPE.
- Medical Surveillance Requirements.
- Requirements for confined space entry.

d. Visitors requiring access to radiologically controlled areas shall complete GJPO Form 1772, "Visitor Dosimetry Issue Form" prior to receipt of dosimetry devices. This dosimetry shall be worn by the visitor at all times while in the radiologically controlled areas.

e. The Project Manager or designated alternate shall approve all "trained" visitor access in the restricted areas. Visitors' entry requirements beyond the restricted areas are:

- Provide documentation of proper training.

- Complete medical surveillance requirements of this MRAP Program HSP and provide the information requested on Geotech Form-1763.

- Comply with all the requirements of this MRAP Program HSP and any site-specific HSP.

f. A fully trained worker/supervisor shall escort visitors at all times. All visitors shall provide signature affirmation that they have read, understand, and shall comply with the requirements stated in this MRAP Program HSP and the site-Specific HSP that applies project site they are visiting.

SECTION 10- DECONTAMINATION

10.1 INTRODUCTION

a. Decontamination station procedures will be posted to allow personnel exiting the controlled area to read through the Step-by-Step requirements.

b. Compliance with the posted decontamination procedures will provide the final protective measures necessary to prevent worker exposure to the hazards present on the site.

c. The procedures contained in this HSP are designed to allow the greatest amount of flexibility in set-up possible. They do not allow deviation from the flow pattern. Failure to complete all steps in sequence may result in off-site release of contamination.

10.2 DECONTAMINATION GUIDELINES

a. Decontamination for radiological contaminants will be accomplished by following the Geotech Manual 103 (Environmental, Safety, and Health Procedures Manual) Section 3.17. Controlled copies of this manual are maintained in the custody of the SHSC at the millsite.

b. Personal protective equipment other than hard hats, safety glasses, and safety shoes worn on site will not be worn off site. All site personnel shall utilize the step-off decontamination sequence whenever they leave the site.

c. If site conditions require that the level of protection be changed, the decontamination procedure will be modified by the SHSC.

d. The decontamination station at any of the sites will include suitable receptacles for the disposal of used protective clothing.

1. Polyethylene bags may be used for this purpose provided they are sealed daily.

2. Contaminated protective clothing will not be removed from the decontamination area until it has been properly bagged.

e. Adequate facilities for washing hands will be available at the decontamination station.

1. Hands will be washed prior to eating or drinking and before leaving the site at the end of each shift.

2. Personnel will shower at the first opportunity after completion of daily site activity.

10.3 EQUIPMENT DECONTAMINATION

a. Before leaving the site, potentially contaminated equipment will be decontaminated by the operator of the equipment. Verification that equipment leaving the site has been adequately decontaminated is the responsibility of the SHSC.

SECTION 11- EMERGENCY PROCEDURES

11.1 PURPOSE OF EMERGENCY PROCEDURES

a. The purpose of the emergency procedures is to minimize the impact of any emergency or unusual occurrence upon the health and safety of personnel performing activities. These procedures also provide the preparedness and identify the manpower and equipment resources available to cope with industrial, radiological, and natural emergencies. Specific responses to accidents, injuries or natural emergencies are contained in the appendices to this section. Each is marked with a tab to provide for easy identification.

11.2 KEY PERSONNEL

a. The key personnel at the work location are those with authority and training to respond to accidents and unusual conditions.

1. The Program Manager is a Geotech employee, as are all the key personnel positions that are identified in the MRAP Program HSP. A listing of the current people performing as these positions will be identified in the site-specific HSPs using the following format:

Geotech Personnel

Operations Director	Name	Phone ext
Manager, HS&S	Name	Phone ext
Program Manager	Name	Phone ext
Project Manager	Name	Phone ext
Field Engineer	Name	Phone ext
Operational H&S Supervisor	Name	Phone ext
Geotech SHSC	Name	Phone ext

Additional Personnel

Name/Title	Organization/Branch	Phone ext

Role and Responsibilities: _____

_____

_____

_____

_____

b. Additional Personnel are:

1. Construction Inspector (CI)

2. Health Physics Technicians (HPT)

3. Other Geotech Field Teams

4. Subcontractor Foreman

5. Local Responders

c. The names and telephone numbers of the Geotech CI and HPT shall be posted conspicuously on the site. The phone numbers of the local responders is also required. The other numbers are:

San Juan Hospital	(801)587-2116
Monticello Police	(801)678-2535
Monticello Ambulance	(801)587-2116
St. Mary's Air Life (Grand Junction, CO)	(303)344-2550
Monticello Fire Dept.	(801)587-2500
Geotech Monticello Office	(801)587-2153
Geotech Grand Junction	(303)248-6073

d. Geotech Key Personnel - The key personnel will respond to emergencies according to the specific procedures found in this plan and the appendices to this section.

e. Local Emergency Responders - The local emergency responders include the fire department, ambulance personnel, police and sheriffs departments. These persons will operate according to their charter and authority. In many cases, they are empowered, by law, to take control at the scene and direct actions.

f. Succession of Authority - The succession of authority is as follows:

Construction Inspector
Health Physics Technician
Other Geotech Team Leader or Supervisor
Occupational Health and Safety Technician
Qualified Junior OHS Technician
Other Geotech Team Leader or Supervisor
Fire Department Hazmat Team

11.3 EQUIPMENT

a. In an emergency, equipment will be necessary to communicate with local responders, rescue and treat victims, to protect response personnel, and to mitigate hazardous conditions on site.

1. Communications - Communications on the various sites include the telephone, portable radios, and voice communication.

a) Telephone - Telephone service is not usually provided on site and under normal circumstances personnel must leave the site and go to a public phone. However, Geotech will ensure that phone service is established at the millsite prior to initiation of significant construction activities. Geotech also maintains a telephone at its local office in Monticello. The telephone number in the Geotech Monticello office is (801)587-2153. The 24 hour per day telephone at the Grand Junction Projects Office is (303)248-6073.

b) Portable Radios - The CI and other Geotech personnel must have radios that may be used to communicate emergency information. These radios are most likely to be used to make the initial notification to the CI, who will notify the local emergency responders if telephone service is not available at the accident scene.

2. Heavy Equipment - The heavy equipment used for the day-to-day operations may be required to perform double duty during an emergency. This equipment should be maintained in running condition and with a fuel level greater than one-fourth full. Equipment repairs should be conducted when the defect is detected so that the equipment is always available for use.

3. Personal Protective Equipment - To meet the needs of any credible accident, PPE must be kept in reserve and maintained for emergency use. This equipment may be from the same stock that is used for daily operations provided a portion is reserved for emergency use and the stocks not depleted. The next level of protection from that used for routine operations must be available. For example, if Level C is the maximum routine level of protection used, then Level B protective equipment must be on hand for emergency use. This may include maintaining SCBA units on a site using only filter respirators.

4. Other Equipment - Each site must also maintain first aid and decontamination equipment necessary to treat injured persons. The minimum equipment on hand must include:

a) First-aid kits (each subcontractor and HPT vehicle).
b) Fire extinguisher and blanket (each subcontractor and HPT vehicle).
c) Pressurized eye wash and quick drench shower.
d) 10 gallons of water, in portable containers (each subcontractor).
e) Decontamination solutions appropriate for the on-site hazards. (if applicable)
f) Containers to hold contaminated materials. (if applicable)
g) Air horn for emergency alarm.

5. The SHSC is responsible for the correct placement of the emergency equipment on the site.

11.4 RESCUE TEAM

a. A rescue team will be required when work is performed in areas that are immediately dangerous to life or health (IDLH). The rescue team will standby near the restricted area boundary ready to rescue any workers whose health and safety is endangered. This will require the rescue team to be fully dressed for the conditions in the Exclusion Zone.

11.5 ALARMS

a. Evacuations - Evacuations will be signaled by two 5 second blasts of an air horn every 30 seconds, and will continue for 3 minutes or until all persons are clear of the area.

b. Take Cover - The alarm for persons to take the nearest cover is 3 successive blasts of an air horn, 1 second each, about one second apart. The series of blasts will continue at 20 second intervals for 3 minutes.

c. All Clear - The signal for all clear is one 5 second blast on an air horn. —

d. Evacuation drills will be conducted at an interval deemed appropriate by the SHSC and the CI but not less than once every three (3) months.

11.6 REFUGE/TOPOGRAPHY

a. Site topography, layout and prevailing weather conditions will be discussed by the SHSC and Field Engineer in relation to emergency response.

b. Safe distances and a place of refuge will be determined on site by the SHSC and Field Engineer - This information will be promulgated to all site employees during pre-work training.

11.7 NOTIFICATION AND REPORTING OF OFF-NORMAL EVENTS

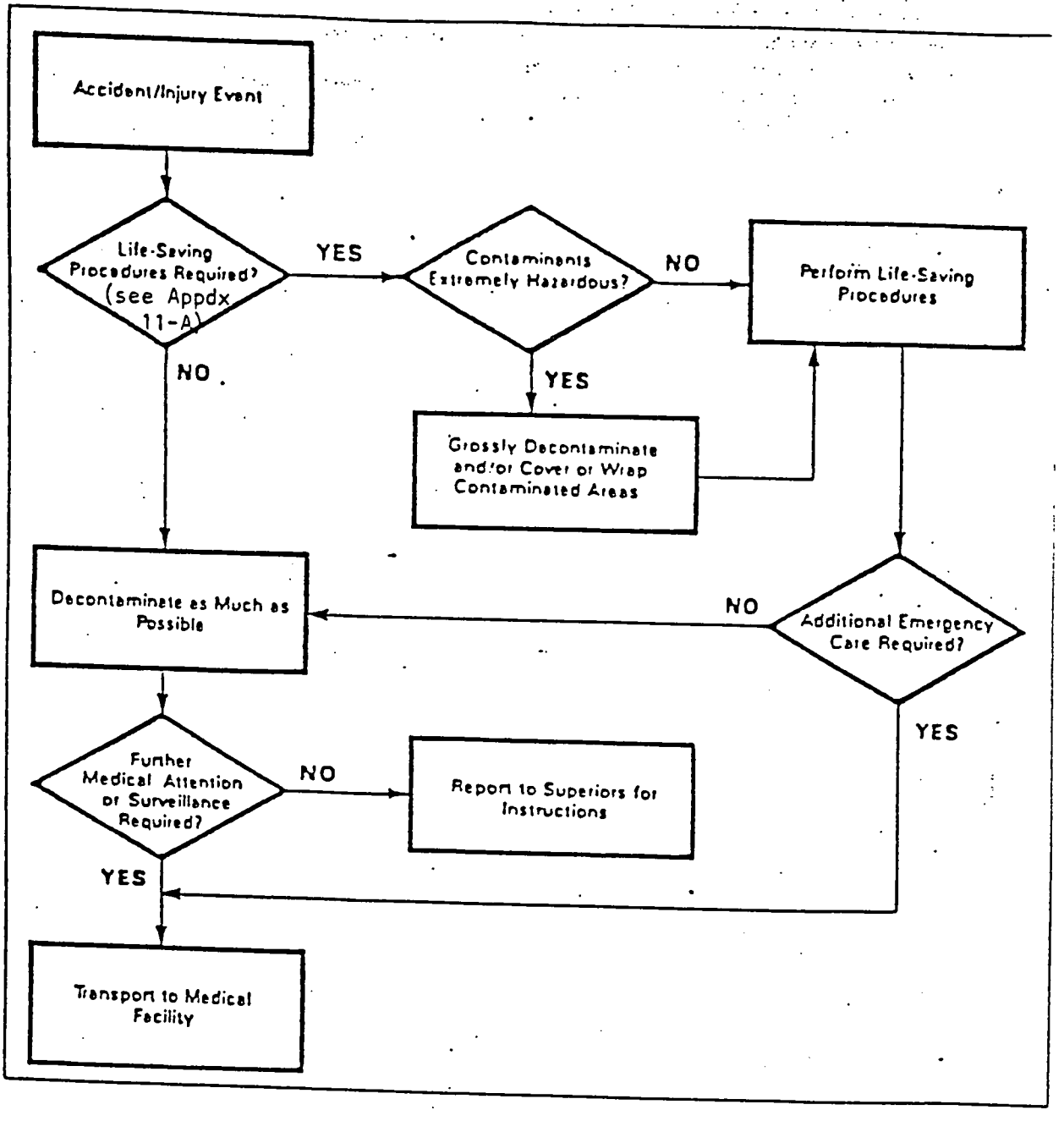
a. Notification of Events - The CI will notify Geotech in Grand Junction immediately after the discovery of an accident, injury or off-normal event. Requirements for this notification are contained in Geotech Manual-103 "Environmental, Safety, and Health Procedures" Chapter 7. Personnel at GJPO will make notification to outside agencies according to Chapter 7. Controlled copies of this manual are maintained in the custody of the SHSC.

b. Reporting of Events - The Project Manager will report accidents, injury or off-normal events in accordance with the reporting requirements contained in Geotech Manual-103 "Environmental, Safety, and Health Procedures" Chapter 7.

11.8 EMERGENCY DECISION TREE

a. Management personnel involved in responding and recovery of emergencies should use the following decision tree for guidance (Figure 11-1).

Figure 11-1. Decision Tree for Emergency Response Action



APPENDIX 11A

WORKER INJURY

If an employee working in a contaminated area is physically injured, Red Cross First-Aid procedures will be followed in addition to the steps detailed below.

The types of injuries are varied. This procedure does not specify the method of treatment. This is the function of the first aid and CPR training. This action guide applies to:

- o Fractures, Dislocations, Sprains and Strains
- o Cuts, Scrapes and Bites
- o Heat Illnesses
- o Heart attacks and strokes
- o Seizures
- o Diabetic Emergencies
- o Poisoning
- o Burns, including fire and chemical

1. **Call for medical assistance** - The ambulance number is 587-2116 or use the radio. Then when time permits, call the CI and HPT.

2. **Life Saving Procedures Required (Immediate Danger)** - If the area is immediately dangerous to life or health (IDLH), then the victim should be moved if it is safe for assisting personnel. Examples include fire, lack of oxygen, serious traffic hazard, risk of explosion, collapsing material or electrical hazards. Move victims according to American Red Cross Standard First Aid Procedures. Persons trained and qualified in first aid should direct those not trained.

3. **No Immediate Danger** - If the area presents no immediate danger, you should follow emergency action principles and care for the victim at the scene. Your task will be to prevent further injury to the victim. Moving the victim could make the injuries worse. If contamination does not present an immediate danger the victim should not be moved. An evaluation to move the victim will be made when emergency medical help arrives.

4. **Treating and Decontamination** - When an injured person is contaminated, a decision will be required to give priority to the first aid actions or decontamination. The decision tree, Figure 11-1, should be used to help make this decision.

5. **Decontamination** - If decontamination is necessary, follow the procedures contained in this plan. If an injured person is transported to a medical facility contaminated, an HPT will go to the facility to assist and advise the medical personnel.

6. Notify the Geotech PM at GJPO.

APPENDIX 11B

CHEMICAL BURNS

Burns occur when chemicals contact the eyes and/or skin of workers. If this occurs, perform the following:

THE FIRST TWO STEPS SHOULD BE PERFORMED QUICKLY

1. **Call for medical assistance** - The ambulance number is 587-2116 or use the radio. Then when time permits, call the CI and HPT.

2. **Flush the Area** - Flush the area immediately with large amounts of water. Continue for 15 to 30 minutes. For chemicals in the eyes, lift the lower and upper lids and flush the eyes.

3. Remove any affected clothing or jewelry.

4. Care for shock.

5. Consult the first aid manual on additional care.

6. Notify the Geotech PM at GJPO.

APPENDIX 11C

FIRE

1. **Localized Fire** - If a localized fire breaks out, the appropriate fire extinguishers will be used to bring the occurrence under control. If necessary and feasible, a fire blanket, soil, or other inert materials will be placed on the burning area to extinguish the flames and to minimize the potential for spreading. The Monticello Fire Department will be notified of any and all fires.

2. **Uncontrolled Fires** - If an uncontrolled fire develops or additional assistance is needed, call the Monticello Fire Department at 587-2500. A written Memorandum of Understanding (MOU) will be established between Geotech and the Monticello Fire Department.

   a. Immediately evacuate the area and stand clear.

   b. If the fire releases potentially toxic gases, all persons in the immediate vicinity must be evacuated. Use the air horn and sound the alarm.

   c. Evacuate upwind to avoid chemical exposure to the designated assembly area. Supervisors are to account for all of their personnel.

   d. Inform the fire department of the toxic gases, if applicable.

3. The CI must evaluate if additional personnel are required to support the response actions. If so, a call for assistance must be made to Geotech at Grand Junction. Qualified personnel will then be dispatched to assist in the response and recovery.

4. Notify the Geotech PM at GJPO.

APPENDIX 11D

NATURAL DISASTERS

Natural disasters may occur at the properties due to weather. These include lightening, high winds and although unlikely, a tornado.

1. Lightening - Persons should not work in open areas, near trees or other equipment outside during lightening storms. Stop work until the storm passes. If possible, clear the site until the storm passes. If there is insufficient time, sound the "take cover" horn, which signifies for persons to enter buildings or automobiles.

2. High Winds - If high winds are forecast, including tornadoes, then the site should be cleared before the winds become hazardous. Workers should be instructed to go to an appropriate shelter. If a rise in winds is sudden, use the "take cover" or "evacuate" horn as appropriate.

3. If an evacuation is called, account of all persons before leaving the site. If a take cover is called, account for personnel after the all clear.

4. Notify the Geotech PM GJPO of any work stoppage due to lightening and high winds.

SECTION 12- SAFETY

12.1 CONFINED SPACE ENTRY

a. No confined space entries are planned within the scope of work.

b. Geotech Manual 103, "Environmental, Safety, and Health Procedures" Chapter 2.7 provides Standard Operating Procedures for use in confined space entry.

12.2 EXCAVATION SAFETY

a. All excavation activities shall be conducted in compliance with all applicable UOSHA regulations as follows:

b. As a minimum, the following rules shall be strictly observed:

1. Excavation into which employees may be required to descend shall be sloped, shored, or stepped in accordance with UOSHA regulations. All excavations over 20 feet deep shall be evaluated by a registered engineer.

2. Excavation spoils shall not be placed within two feet of the edge of the excavation.

3. All excavations will be inspected by a competent person daily, after every rainstorm, and after other hazard-increasing occurrences.

a) All structures adjacent to any excavation exceeding 5 feet will be examined by a competent person to ensure that no unsafe conditions exist.

4. Trees, boulders, and other surface encumbrances located so as to create a hazard to employees involved in excavation or in the vicinity thereof, at any time during operations, will be removed or made safe before excavating is begun.

5. At any time entry into an excavation is required, a standby person shall be available. Requirements for wearing a lifeline and harness in addition to the protective clothing described in Section 6.0 of the HSP will be determined on a "case by case" basis to avoid creating an undue hazard.

7. For all excavations/trenches in excess of 4 feet deep appropriate access methods, such as ladders or ramps, will be used to enter the excavation. Under no circumstances will an employee be permitted to ride backhoe buckets or other similar equipment to enter or exit the excavation. These access locations will be spaced no farther than 25 feet travel distance.

12.3 FIRE SAFETY

a. As a fire prevention measure, no smoking or fires shall be permitted within any controlled or restricted areas, and wherever there may be dry grass, other flammable material.

b. Vehicles and equipment will not be left idling or parked in or around areas where catalytic converters may cause grass fires.

c. Hot work, such as welding or cutting, shall be performed only as absolutely necessary and requires a permit. Hot work shall only be conducted after a site inspection for fire hazards. At least two appropriate fire extinguishers shall be available during hot work procedures.

d. Work areas with strong fences, such as a chain link fence, must have two exits that are unlocked while work is in progress. The exits may be locked if each person has a key.

e. All flammable and/or combustible liquids brought on site shall be handled/stored in a manner consistent with all current UOSHA Regulations.

12.4 ELECTRICAL SAFETY

a. If temporary electrical power is provided, the NFPA 70 (National Fire Protection Association) will be adhered to. Also, all state and local codes will be followed. All wiring will be done by journeyman electricians.

b. To help minimize the hazard of electrical equipment used on site (i.e.; portable generators), low-voltage equipment with ground-fault interrupters and water-tight, corrosion-resistant connecting cables will be used.

c. To eliminate lightning as a hazard, operations will be suspended during electrical storms.

d. Any capacitors that may return a charge will be properly grounded before handling.

APPENDIX A

Bioassay

The bioassay program consists of collecting routine urine samples which are analyzed for Ra-226. The program has two components: 1) Prospective (workplace) monitoring; and 2) retrospective (individual worker) monitoring.

Prospective (workplace) monitoring will consist of air sampling and urine sample collection. Air sampling will be the primary method of monitoring the workplace. Urine samples will be collected from representative workers (i.e. workers chosen to represent a particular work environment) every 6 days. This will be accomplished by rotating the workers on the routine (retrospective) bioassay program such that each individual employee involved in the routine program submits a urine sample every 26 days. If the air sampling data or urine samples indicate an intake which is expected to exceed 0.02 ALIs (40 DAC-h), all workers in that work environment involved in the exposure event will be required to submit two follow-up urine or fecal samples. The determination of the potential individual workers in the exposure event and the required follow-up sample type will be the responsibility of the Health Physicist in charge of the bioassay program.

Retrospective (individual worker) monitoring will consist of routine urine sample collections from individual workers every 26 days. If the routine urine sample indicates an intake expected to exceed 0.02 ALIs, two follow-up bioassay measurements of assessments of internal dose shall be performed for a confirmed intake or total of all intakes until the projected internal dose is less than 10 mrem annual effective dose equivalent.

Workers will be included in the routine bioassay program if they could be exposed to surface or airborne contamination such that they could receive an annual effective dose equivalent in excess of 100 mrem, or if any organ or tissue annual dose equivalent could exceed 5 rem. The Health Physicist responsible for the bioassay program, in cooperation with the employee's immediate manager, will determine which employees are to be included in the routine bioassay program.

Personnel whose duties involve only observations or supervision and who spend less than 25 percent of the work week in an area where routine bioassay measurements are required, should participate in the program on a limited basis. The degree of participation of such personnel depends on the circumstances and will be determined by the Health Physicist in charge of the bioassay program.

Urine samples will be required for new hires and radiation workers transferring to another facility to determine their baseline. Urine samples will also be required from employees termination employment.

APPENDIX B

Subcontractor Health and Safety Plan Evaluation

Subcontractor's Name _____

Street Address _____ Phone Number _____

City _____ State _____

Health and Safety Contact _____ Phone Number _____

Activities to be conducted by subcontractor:

_____

_____

_____

_____

_____

_____

EVALUATION CRITERIA	YES/NO	If NO, What subcontractor action required?
Does the subcontractor HSP identify "per-task" evaluations of the safety and health hazards at the site?	_____	_____
Does the subcontractor HSP specify employee training to the level required by job function and responsibilities?	_____	_____
Does the subcontractor HSP require documentation of the employee training consistent with Geotech requirements?	_____	_____

EVALUATION CRITERIA	YES/NO	If NO, What subcontractor action required?
Does the subcontractor HSP contain requirements for site-specific training that addresses the minimum topics required by OSHA?		
Does the subcontractor HSP contain requirements for radiation worker training that addresses the minimum topics required by DOE?		
Does the subcontractor HSP identify "per-task" administrative and engineering controls to mitigate hazards?		
Does the subcontractor HSP identify "per-task" personal protective equipment when engineering controls are insufficient?		
Does the subcontractor HSP identify the frequency and type of air monitoring, personnel monitoring, and area sampling?		
Are maintenance and calibration procedures for sampling equipment identified?		
Does the subcontractor HSP specify medical surveillance for employees that meets the OSHA criteria?		
Does the subcontractor HSP specify site control measures consistent with Geotech requirements?		
Does the subcontractor HSP identify decontamination procedure consistent with Geotech requirements?		
Does the subcontractor HSP contain an emergency response plan that is compatible with Geotech, local, state, and federal plans?		
Does the subcontractor HSP contain safe work procedures for confined space entries?		
Does the subcontractor HSP contain a spill containment program?		

REVIEW:
Review and Approval Signatures:

_____ / _____
Project Manager Date

_____ / _____
Operational Health and Safety Representative Date

_____ / _____
Radiological and Environmental Safety Representative Date

APPENDIX C

LIST OF REFERENCES

1. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities; Department of Health and Human Services ,Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; October 1985.

2. NIOSH guide to Industrial Respiratory Protection; Department of Health and Human Services ,Centers for Disease Control, National Institute for Occupational Safety and Health; Sep 1987.

3. Guidelines for the Selection of Chemical Resistant Clothing, 3rd Edition, Volume I - Appendix I, "Definition of Protection Levels";NTIS Report No. AD A179-516.

4. Geotech ES&H Desk-Top Procedure.

5. Geotech Manual-103, "Environmental, Safety, and Health Procedures".

6. 29 CFR 1926, Subpart P as amended by Federal Register, VOL. 54 No. 209, dtd 10/31/89.

7. UOSHA Hazardous Waste Operations and Emergency Response. R 500-108-120

8. UOSHA Rules and Regulations Manual

9. 29 CFR 1910.120

APPENDIX D

PROJECT SPECIFIC HEALTH AND SAFETY PLAN (HSP)

FOR ADDITIONAL CHARACTERIZATION OF MILLSITE AREA AT MONTICELLO, UTAH

PROJECT SPECIFIC HEALTH AND SAFETY PLAN (HSP)

FOR ADDITIONAL CHARACTERIZATION OF MILLSITE AREA AT MONTICELLO, UTAH

Review and Approval Signatures:

Brian Wilson / 3-1-91

Brian Wilson, Technical Monitor Date

_____ / _____

Thomas Richards, Operational Health and Safety Manager Date

_____ / _____

Gordon Meade, Radiological and Environmental Safety Date

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PROJECT SPECIFIC HEALTH AND SAFETY PLAN (HSP)

FOR ADDITIONAL INVESTIGATION AND CHARACTERIZATION

OF MILLSITE AREA AT MONTICELLO, UTAH

1.0 GENERAL INFORMATION

1.1 Project Identification

This portion of the Monticello Remedial Action Project (MRAP) involves additional soils and contamination characterization of the tailings piles (Operable Unit Number I). The site and its contamination are described in the Final Remedial Investigation/Feasibility Study (RI/FS) Number DOE/EA--0424.

This appendix is a project specific HSP operating under the auspices of the Monticello Remedial Action Project Programmatic Health and Safety Plan, Revision 1, February 1991. In case of conflict, this appendix takes precedence over the programmatic plan.

1.2 Project Duration

Approximate start date is April 1991, and approximate end date is July 1991.

1.3 Project History

As described in the MRAP Programmatic HSP Section 1.6, History, and Section 1.7, Description of Milling Processes, this site was used for vanadium/uranium ore buying and milling from 1940 until 1962. The ores came from a wide geographic area and had a variety of metallurgic properties. Likewise milling operations used a variety of processes. Tailings were piled on site. Some wastes washed into the creek. Early cleanup activities included some removal and relocation of tailings as well as grading and seeding.

In 1980 the millsite was accepted into the Surplus Facilities Management Program (SFMP) and MRAP was established to restore the government-owned millsite to safe levels of radioactivity and to dispose of or contain the tailings in an environmentally safe manner. Surveillance activities have been continued since 1980. The site is administered by the Grand Junction Projects Office of the Department of Energy.

Since the tailings piles are near to the town of Monticello, Utah, and since leachate from the piles contaminates the ground water, it has been proposed that the tailings piles be removed to a containment cell south of their present location.

1.4 Scope of Work

The scope of work for this project involves further classification of site materials and contamination at the millsite area, the tailings piles, the BLM Compound, and other contaminated areas. The purpose of the additional investigation is to gain a more accurate determination of the quantities and characteristics of the materials to be handled. This requires the drilling of approximately 82 boreholes in specified locations, the collection of soil samples from those boreholes, the installation of observation wells in those boreholes, and the digging of approximately 16 test pits.

1.5 Hazard Assessment Overview

The following types of hazards have been identified as relevant to this site. See Section 3 for details.

- o Physio-chemical: Toxic Chemical
- o Inorganic Substances
- o Radioactive Materials
- o Bio-hazards
- o Physical Hazards
- o Construction Hazards

1.6 Subcontractor Health and Safety Plan Acknowledgement

As required by Section 8.4 of the MRAP Programmatic HSP, acknowledgement of HSP information as listed below will be obtained from each Subcontractor:

- o Identification of Subcontractor Company
- o Subcontractor Acknowledgement of Receipt of this HSP
- o Lower Tier Subcontractors' Acknowledgement of Receipt of this HSP and of Subcontractor's HSP
- o Geotech Acknowledgement of Receipt of Subcontractor's HSP
- o Geotech Operational Health and Safety (OHS) Indication of Approval of Subcontractor's HSP

1.7 Field Change Records

Requests for initiating field changes to the site specific HSP are to be made through the Technical Monitor by completing the information requested in Figure 1.7-1, HSP Field Change. The Technical Monitor is responsible for obtaining the necessary review, concurrence, and approvals for the Field Change; for maintaining a log of Field Changes shown by example in Figure 1.7-2; and for assuring distribution of the Field Change to appropriate personnel (HSP document holders).

Field Change Notices will be maintained as attachments to the site-specific HSP.

FIELD CHANGE

Field Change Number:_____ Date Effective:_____

- *Pen and Ink* changes to be made in the HSP to alert the reader of this change:

- Reason for the change to be incorporated into the HSP:

- Text of Change to be incorporated:

Review and Approval Signatures:

_____ / _____
Technical Monitor Date

_____ / _____
Operational Health and Safety Manager Date

_____ / _____
Program Manager Date

Figure 1.7-1 Field Change Form

FIELD CHANGE NUMBER	DATE ENTERED	SYNOPSIS OF CHANGE	INITIAL

Figure 1.7-2

2.0 KEY PERSONNEL ASSIGNMENTS

2.1 Geotech Personnel

A. Program Management

UT/ID Operations Director	Brian Mathis	248-6355
SFMP/DD&D Program Manager	Harry Perry	248-6018
SFMP/DD&D Construction Manager	Irwin Stewart	248-6338
MRAP Project Manager	David Scheuerman	248-6140

B. Health and Safety (H&S) Management

Health, Safety, and Security Manager	Travis Best	248-6073
Operational H&S Manager	Thomas Richards	248-6717

C. Project Personnel

Technical Monitor	Brian Wilson	248-6495
Field Representative	Brian Werle	248-6471
Operational H&S Supervisor	Syd Pincock	248-6708
Geotech Site H&S Coordinator	To Be Announced	

2.2 Additional Personnel

Additional Geotech or Subcontractor personnel may be on site for various tasks. Before they begin their tasks, these persons and their responsibilities will be identified to Geotech and Subcontractor personnel.

Documentation of changes or additions in personnel or responsibilities will be continuously updated and distributed to those involved in the project.

3.0 SAFETY AND HEALTH ASSESSMENT

3.1 Task Identification and Hazard Assessment

TASK 1: Drill Boreholes

TASK 2: Take Soil Samples from the Boreholes

TASK 3: Install Monitoring Wells in each Borehole

TASK 4: Dig Test Pits and Take Samples from Pits

Safety Procedures for these tasks shall be provided by the Subcontractor and approved by Geotech. For the drilling (Task 1) the Subcontractor's Safety Procedures shall be consistent with the Drilling Health and Safety Plan (Attachment 3), as modified by the following additions:

- Section 1: The drill rig operator shall make safety inspections, checks, and tests at the beginning of each shift rather than "daily."

- Section 1, last bullet: A site-specific map showing the route to the hospital shall be posted on or near the drill rig.

- Section 2, last bullet: Any special individual protective equipment required for the site must be specified on the Subcontractor's Safety Procedures. This information can be found in Section 4 of this HSP.

- Section 9, first bullet: The location of utility lines will require that utility companies be involved per Chapter 15 of the Field Assessments Procedures Manual (Geotech, July 27, 1990).

The following material identifies hazards known or suspected to be present when accomplishing the tasks involved in this project.

All tasks have in common the dangers of simply being present on a hazardous waste site and the consequent exposure to the chemicals in the tailings and to the radiologic activity of uranium and radium. Extremes of weather or storms are not easily predictable but in some situations could be hazardous. Work on this site may also involve buried tanks, natural gas pipelines, overhead power lines, energized electrical systems, grade of terrain, and hot or cold working conditions.

Construction hazards include the use of pressurized equipment and heavy equipment such as backhoe and drill rig.

TASK 1. Drilling involves a number of physical hazards from the use of heavy equipment, the danger of hitting utility lines either overhead or under the ground, dangers of improper lifting, and the possibility of being caught by rotating machinery.

TASK 2. In addition to the possible hazards of working near drilling machinery, those who take the samples may face risks from close contact with the materials being sampled.

TASK 3. The installation of monitoring wells also includes hazards of heavy machinery similar to those for Task 1.

TASK 4. Digging test pits includes the hazards mentioned above and also the possible danger of cave-ins if proper procedures are not followed. Those who take the samples may face risks from close contact with the materials being sampled.

3.2 Chemical Hazard Identification

Chemical Hazards Directly Related to Tasks

The following substances have been identified as present in the tailings. Samples were taken in 1979 and used to determine concentrations of certain analytes. In 1983 and in 1987 the same samples were used to determine concentrations of additional analytes. The concentrations indicated (and the average concentrations in parentheses) represent concentrations in soil.

CHEMICAL NAME	SOURCE	CONCENTRATION	OSHA PERMISSIBLE EXPOSURE LIMIT IN AIR*
Antimony	Tailings	<1.0 to 4.8 (<1.0) ppm	0.50 mg/m^3
Arsenic		18 to 179 (71) ppm	0.01 mg/m^3
Beryllium		<1.0 to 3.9 (1.8) ppm	0.20 mg/m^3
Cadmium		<1.0 to 9.4 (3.0) ppm	0.20 mg/m^3
Chromium		13 to 203 (47) ppm	0.50 mg/m^3
Copper		43 to 4650 (1134) ppm	1.00 mg/m^3
Lead		14 to 334 (83) ppm	0.50 mg/m^3
Mercury		<0.040 to 0.660 (0.06) ppm	0.10 mg/m^3 ceiling limit
Molybdenum		2 to 124 (32) ppm	5.00 mg/m^3
Nickel		13 to 91 (35) ppm	1.00 mg/m^3
Selenium		<1.0 to 6.1 (<1.0) ppm	0.20 mg/m^3
Silver		<2.0 to 2.8 (<2.0) ppm	0.01 mg/m^3
Thallium		<2.0 to 3.0 (<2.0) ppm	0.10 mg/m^3
Thorium-230		1 to 578 ppm	7.0×10^{-5} Ci/cc
Radium-226		72 to 2400 (669) pCi/g	8.0×10^{-12} Ci/cc
Uranium		76 to 1500 (319) ppm U	7.0×10^{-5} Ci/cc
Vanadium		6.7 to 32223 (2256) ppm	0.05 mg/m^3
Zinc		62 to 566 (190) ppm	5.00 mg/m^3

*The OSHA permissible exposure unit Time-Weight Average (TWA) identifies the respective unit in air for personnel exposure monitoring (Reference Table 5-1 from Section 5 of the MRAP Programmatic HSP).

Chemical Safety Data Sheets for all chemicals that are known or suspected contaminants at this project site are contained in Attachment 1.

In addition to the tailings hazards listed above, potential hazards may be encountered from the following sources:

- Exhaust emissions from petroleum products used as fuel and lubricants for machinery and vehicles
- Chlorinated hydrocarbons from PCBs and pesticides
- Caustics in the carbonate pile
- Acids in the acid pile
- Airborne silica from fugitive dust
- Montezuma Creek water has been found to have elevated contaminants related to those in the tailings. The water in the creek shall be prohibited for drinking or use in decontamination activities.

3.3 Biological Hazard Identification

The Site H&S Coordinator (SHSC) shall check with the workers at the site to ensure that any allergic or sensitized personnel are identified.

Poisonous Plants: Snowberry can cause humans who eat the berries to become sick. Although this would probably not be fatal, the time of sickness is unpleasant and nonproductive. Many other plants, if eaten, can cause sickness or upset stomachs. The pollen of some plants (Rabbitbrush, for example) triggers unpleasant hay-fever reactions in the many people who are allergic to them. Thistles and cacti can cause minor injuries and splinters that could become infected. Routes of entry include ingestion, inhalation of pollen, and injection (for thistles and cacti).

Insects and Insect-like Creatures: As in most locations, a variety of insects occur. A frequently unpleasant, none would ordinarily be considered deadly except in the case of individual allergies--especially to stings of bees or wasps. The main route of entry is injection.

- Ticks are parasites that feed on the blood of an animal/human host and can carry several severe diseases, the least bringing several days of fever and pain and the worst causing brain damage. Injection is the route of entry.
- Spiders and Scorpions: Some spider bites are deadly like those of the black widow; others like scorpion stings are painful but not usually deadly. Others are unpleasant or uncomfortable, resulting in rashes, itching, and possible infection. The possibility of allergies greatly increases the danger. Since people are not usually aware of such allergies until they have been bitten or stung, such creatures should be regarded as potentially hazardous. Injection is again the route of entry.
- Stings of bees and wasps may cause serious allergic reactions in certain individuals.

Reptiles and Other Animals:

- Of reptiles potentially in the area, the midget-faded rattlesnake is the only one likely to be considered venomous. Route of entry is injection.
- Rabbits have the potential of carrying rabbit fever if the animal contacts a person with a sore on his or her hand. The disease is typically contracted by skinning a diseased animal. Route of entry is a combination of absorption and injection.

- Porcupines are potentially dangerous in several ways: Their quills can puncture, their bites can become infected or can carry rabies or other diseases, and they have been known to bite through vehicle brake lines causing loss of braking ability. The route of entry is injection, but the danger of an uncontrolled vehicle is a different category altogether.

- Skunks can carry rabies and other diseases, as can many other mammals--especially those that would be likely to bite. Route of entry is injection.

- Prairie dogs, chipmunks, ground squirrels, rats, and other mammals have been known to harbor fleas carrying bubonic plague. Their bites too can carry rabies and other infections. Chipmunk-like animals pose a special problem because people tend to try to feed them or pet them, the increased contact bringing greater possiblility of danger. Route of entry is injection either from the bites of fleas or from the animals themselves.

Sewage: Existing sewer lines and septic tanks on the BLM compound have been identified and should be avoided during drilling operations. Possible though unlikely routes of entry would be inhalation of noxious fumes, ingestion, absorption, and if a person had a cut hand, injection.

3.4 Radiological Hazard Identification

Radioactive Materials include surface contamination of Uranium and Uranium decay daughters. Maximum readings for most of the previous samples of Ra-226 are less than 1800 pCi/g; however, spikes have been identified as high as 3200 pCi/g.

Element or Isotope	Activity (pCi/gm for U,Ra)	Decay type	Source	Derived Air Concentration*
Uranium	76-1500	alpha	tailings	6×10^{-10} ?Ci/mL
Radium-226	72-2400	beta gamma	tailings	3×10^{-10} ?Ci/mL
Thorium-230	1-578 ppm		tailings	7×10^{-12} ?Ci/mL

* Derived Air Concentration listed in DOE Order 5480.11

Estimated worker AEDE - 50 mrem

Estimated worker CEDE - 300 mrem

These estimates are tentative and may be adjusted as additional information is received based on monitoring activities by Geotech Operational Health and Safety personnel.

Radiation Worker training and monitoring are required.

SARA training is required for workers on all Monticello sites.

3.5 Physical Hazard Identification

Hazards marked below relate to the specific tasks indicated. For hazards addressed in completed JSAs or OSAs, copies of the completed documents will be attached.

	Hazard (Y/N)	TASK No(s).	JSA Attached
Noise	(Y)	1 4	
Heat - ambient air	(Y)	1 2 3 4	
- Hot Process - Steam	(Y)	1 2 3	
- Hot Process - Incin.	( )		
Cold	(Y)	1 2 3 4	
Rain	(Y)	1 2 3 4	
Snow	(Y)	1 2 3 4	
Electric Storms	(Y)	1 2 3 4	
Confined Space Entry	(Y)	4	
"Hot Work" - Welding	( )		
- cutting	( )		
Heavy Manual Lifting/Moving	(Y)	1 3	
Rough Terrain	(Y)	1 2 3 4	
Structural Integrity	( )		
Remote Area	( )		
Compressed Gases	(Y)	3	
Diving	( )		
Using Boats	( )		
Working over Water	( )		
Traffic	( )		
Explosives	( )		
Heavy Equipment Operation	(Y)	1 2 3 4	
Lift Equip. Operation - Cranes	(Y)	1	
- Manlifts	( )		
Working at Elevation- Ladders	( )		
- Scaffolding	( )		
Excavating/Trenching	(Y)	4	
Materials Handling	(Y)	1 2 3 4	
Haz Mat Use/Storage -flam liq/gas	( )		
-oxidizers	( )		
-corrosives	( )		
Demolition	( )		
Utilities - Underground	(Y)	1 4	
- Overhead	(Y)	1 4	
Electrical - General	(Y)	1 4	
- High Voltage	(Y)	1 4	
Power Hand Tools	( )		
High Pressure Water	(Y)	1 2	

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

4.1 Selection of Ensembles and Equipment

The determination of Engineering Controls, Administrative Controls, Action Levels, and proper PPE shall take into account the task hazard analysis performed in Section 3. All PPE will be provided by Geotech.

GENERAL (TASKS 1-4)

Since all tasks will be performed by a Subcontractor on one site, the safety requirements and level of PPE will be the same for all four tasks. Task 4, however, involves two additional Engineering Controls because of the possible depths of the pits and because individuals may enter these pits to gather samples.

4.2 Engineering Controls

- Utilities will be located prior to drilling.
- If Health and Safety personnel determine that dust control measures are necessary, the Subcontractor will provide Geotech-approved dust-control measures.
- (Task 4 only) Test pits shall have stable side slopes. In no case shall side slopes be steeper than one to one.
- (Task 4 only) Air quality in test pits will be monitored by Health and Safety personnel. If necessary, Geotech will provide ventilation for test pits.

4.3 Action Levels for Posting Requirements

Radiation Dose Rate

>50 microR/hr at 1 ft from source	The Site H&S Coordinator shall follow Geotech Manual-103 Procedure 3.11 for RWP and 3.33 for TLD requirements, HSSHP 0501, and ES&H Desktop Procedures Manual.
>2mrem/hr at 1 ft from source	Follow Manual-103 Procedure 3.3 posting requirements.

Surface Contamination -- Post according to Manual 103 Procedure 3.3, RWP Procedure 3.11 Required.

> 3500 dpm/100 cm	Beta-Gamma contamination (fixed)
> 750 dpm/100 cm	Beta-Gamma contamination (transferable)
> 20 dpm/100 cm	Alpha contamination (other than U and daughters)
> 5000 dpm/100 cm	Alpha contamination due to U and daughters (fixed)
> 1000 dpm/100 cm	Alpha contamination due to U and daughters (transferable)

Airborne Radionuclides

>10% of Derived Air Concentration (DAC)	Post area as "Airborne Radioactive Materials Area", RWP required. Use respiratory protection if required by RWP. All workers who enter area are in bioassay program.
>100% of DAC	Respiratory protection required.

Noise

>80 dBA	Monitor surrounding area.
>85 dBA	Institute engineering controls at or above 85 dBA to mitigate noise. Provide hearing protection if engineering controls do not reduce noise levels below 85 dBA.

Heat Stress

Wearing permeable clothing

>77? F Wet Bulb Globe Thermometer (WBGT)

Monitor temperature with a WBGT and initiate work/rest regime to reduce exposure below TLV for work load.

Wearing impermeable clothing

>72.5? Adjusted Temperature (See Appendix G of the *Program*, Table G-1)

Monitor worker heart rate and oral temperature, adjust work/rest regimes to maintain heart rate below 110 beats/min and oral temperature below 99.6? F.

Temperature-Based Physiological Monitoring

Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers[a]

ADJUSTED TEMPERATURE[b] (° F)	NORMAL WORK ENSEMBLE[c] (min. of work)	IMPERMEABLE ENSEMBLE (min. of work)
90 or Above	After each 45 mins.	After each 15 mins.
87.5 - 90	After each 60 mins.	After each 30 mins.
82.5 - 87.5	After each 90 mins.	After each 60 mins.
77.5 - 82.5	After each 120 mins.	After each 90 mins.
72.5 - 77.5	After each 150 mins.	After each 120 mins.

[a] For work levels of 250 kilocalories/hour

[b] Calculate the adjusted air temperature (ta adj) by using this following equation and guidelines: ta adj ° F = ta ° F + (13 x % SUNSHINE). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate the % SUNSHINE by judging the percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100% SUNSHINE = no cloud cover and a sharp, distinct shadow; 0% SUNSHINE = no shadows)

[c] Normal work ensemble consists of cotton overalls or other cotton clothing with long sleeves and pants.

4.4 PPE Level Required

Modified level D is recommended. Air hazards are not suspected. Soil contaminants are not suspected of being skin (dermal) hazard.

ENSEMBLE COMPONENTS

Route of Exposure	Protection Required ?	Protection Provided By Following:
Respiratory	No	--
Head	Yes	Hard hat during drilling
Eyes	Yes	Approved Glasses meeting ANSI 707.1
Ears	Yes	Protect per 29CFR1926
Face	No	
Hands	Yes	Leather Gloves
Arms	Yes	Tyvek -- Permeable
Trunk	Yes	Tyvek -- Permeable
Legs	Yes	Tyvek -- Permeable
Feet	Yes	Foot Protection meeting ANSI 741.175
Boot coverings	Yes	Rubber Overshoes
TLD	Yes	

In general, PPE will be properly disposed of instead of decontaminating. If PPE decontamination is required, Geotech's Site H&S Coordinator (SHSC) will implement procedures to do so.

5.0 TRAINING ASSIGNMENTS

5.1 Employee Training/Medical Certification File

The Technical Monitor shall initiate individual Employee Training/Medical Certification Files for each employee working at the project site. These files will contain the training records and medical approval statement required for each Geotech and Subcontractor employee. These files will be kept at the project site to allow ready access of the information for the employees and any auditors. A worker/supervisor training medical checklist is provided in Attachment 2. Documentation of the following training will be maintained in this file. Geotech training documentation is maintained by the Employee Training and Development subsection of Human Resources. Medical approval will be verified through the manager of the occupational medical program. The Technical Monitor will obtain verification of each employee's training and maintain in file on site.

1. Worker/Supervisor Training Check List. It is the responsibility of the Subcontractor to furnish Geotech with this completed document for each worker prior to work.

2. *Initial/Refresher Hazardous Waste Site Health and Safety Training.* This training shall be provided by the Subcontractor. The Subcontractor shall furnish Geotech with documentation of training prior to work.

3. *Initial/Refresher Supervisor Hazardous Waste Site Health and Safety Training* This training shall be provided by the Subcontractor. The Subcontractor shall furnish Geotech with documentation of training prior to work.

The following training shall be provided by Geotech. Documentation of the training will be provided by completion of the Training Attendance Sheet (Geotech Form GJPO-1720).

4. *Radiation Worker Training* (HS 102, HS 103).

5. Site-Specific training (Pre-entry briefing).

6. HS 312, *Respiratory Protection Wearer Training,* if required by site conditions.

The training indicated by the following two items shall be provided by the Subcontractor. The Subcontractor shall furnish Geotech with documentation when item 7 is completed.

7. Form-1757, *Supervised Field Training (OJT)* This training must be performed by a "SARA supervisor." See Attachment 2 for Form -1757.

8. HS303 ROTA, *Hazards Communication Standard Training.*

5.2 Access Limitations

Access to the controlled areas of the project site shall not be granted to any employee or subcontract employee who has not completed and documented the training requirements specified on the Worker/Supervisor Training Check List.

6.0 MEDICAL SURVEILLANCE

6.1 Required Information

The Geotech employee shall complete Form 1763, Occupational Medical Program Employee Information for this project site. The Geotech employee shall document potential exposure times at the project site on Form 1733, Hazardous Materials Access Log, throughout the duration of work at the project site. OH&S shall submit Form-1763 and each Form 1733 to the SHSC, who shall in turn submit to OMP. These forms will provide the required information for baseline, periodic, and termination physicals.

6.2 Record-keeping

The OMP will maintain the original Form 1763 and completed Form 1733s, along with the exposure data gathered during area sampling and personnel monitoring. These records must be accessible to the employee for review.

6.3 Pre-Project Physicals

The Subcontractor is responsible for the following requirements for subcontract employees:

- Medical examinations meeting all requirements of 29 CFR 1910.120 must be performed on each Geotech and Subcontractor employee prior to commencement of work.
- In addition, a SERUM heavy metals screening, pulmonary function test, and EKG must be conducted. The physician must provide Geotech with a statement declaring a SERUM heavy metals screening was conducted and that the employee can wear a respirator. Medical verification requires a statement containing the following five items:
  - Physician's name (typed or printed),
  - Physician's signature,
  - Physician's address,
  - Physician's telephone, and
  - Physician's state license number.

7.0 SITE MONITORING

7.1 Equipment and Instrumentation

7.1.1 Air Monitoring Instruments

The procedures for operation and maintenance of the direct reading air monitoring instruments used at the project site are contained in ES&H Desktop Procedures.

7.1.2 Radiation and Contamination Survey Instruments

The procedures for operation and maintenance for the radiation and contamination survey instruments used at the project site are contained in DESKTOP and in Geotech Manual-103, *Environmental, Safety, and Health Procedures Manual*.

7.1.3 Worker Breathing Zone Sampling Equipment

The procedures for operation and maintenance for the worker breathing zone sampling equipment shall be used at the project site are contained in DESKTOP.

7.1.4 Physical Hazards Monitoring Equipment

The procedures for operation and maintenance for the physical hazards monitoring equipment used at the project site are contained in DESKTOP.

7.2 Site Air Monitoring Program

The SHSC will monitor Geotech employees for total metals, organic compounds, respirable silica, and airborne radioparticulates. In addition the SHSC will monitor subcontract employees for airborne radioparticulates. The Subcontractor is responsible for monitoring subcontract employees for total metals, organic compounds, and respirable silica.

TASK # 1-4

Type of Monitoring/ Surveying	Frequency of Monitoring/ Surveying	Location of Monitoring/ Surveying
Total Metals Resp. Silica	Monitoring daily for first week of employment most likely until characterized, then periodic or when conditions change.	Worker Breathing Zone
Airborne Radioparticulates	Daily for worker most likely to be exposed	Worker Breathing Zone
Vanadium	To Be Announced	TBA
Organic Compounds	To Be Announced	At Drill Hole or Excavation

8.0 PROJECT SITE CONTROL

8.1 Site Map

The Subcontractor shall develop and post a "Site Map" of the project site in a conspicuous location in the Support Zone. The SHSC shall indicate the locations of the following on the Site Map:

1) First Aid Stations

2) Evacuation Routes

3) Fire Control Equipment

4) Communications Equipment

5) Sanitary Facilities

6) Support Facilities

8.2 Site work zones

Work Zones must be establish as controlled areas, as necessary, to provide protection for untrained, and/or unprotected personnel.

The SHSC shall--

Direct the proper placement of zone boundaries at the site, including the placement of the HOT LINE. Changes of the established HOT LINE location requires approval by the SHSC.

Direct the establishment of the ACCESS CONTROL POINTS at both ends of the DECONTAMINATION CORRIDOR. Proper operation of the control points will manage the flow of personnel and equipment into and out of the work area.

Update the locations of the controlled area boundaries on the "SITE MAP."

Ensure that the boundaries are controlled and posted clearly.

Communicate the entry requirements for the control zones to all personnel at the project site.

Maintain the Hazardous Materials Access Log for the project.

8.3 Site Communications

Site Communication methods will be announced. It is anticipated that an air horn will be used for indication of emergency.

- Additional emergency communication procedures information is contained in the Emergency Response section of this HSP.

8.4 Safe Work Practices

- The SHSC shall ensure that the "Buddy System" is used for all operations at the site.

- The SHSC shall maintain the following Procedural Manuals to be used at the site for STANDARD OPERATING PROCEDURES:

  1) Geotech Manual-102, *Environmental, Safety, and Health Policy Manual*

  2) Geotech Manual-103, *Environmental, Safety, and Health Procedures Manual*

  3) *ES&H Desktop Procedures Manual*

  4) *Field Assessment Procedure Manual*

8.5 Visitors

- The SHSC shall provide a briefing to all visitors to the project site. All visitors shall complete Visitor Briefing. Visitor Briefing shall be documented as site-specific training on the Worker/Supervisor Training and Medical Approval Check List. The SHSC shall retain copies of the training at the project site.

- All "untrained" visitors shall be escorted by a trained supervisor while at the site. The Project Manager or designated alternate shall approve all "trained" visitor access past the Support Zone. Visitors entry requirements for the controlled areas (beyond the contamination control line) are--

  Provide documentation of training required.

  Complete medical surveillance requirements in Section 6 of this HSP and provide the information requested on Geotech Form-1763.

  Comply with all the requirements of this HSP.

9.0 DECONTAMINATION

9.1 Decontamination Procedure Selection

When the project site has a combination of radiological and non-radiological hazards the project manager shall work closely with OHS and R&ES to develop a decontamination procedure specific for the site. This procedure shall be attached to this HSP.

10.0 EMERGENCY RESPONSE PLAN

Section 11.0 of the MRAP Programmatic HSP provides additional procedures.

10.1 Emergency Contacts and Phone Numbers

The Subcontractor shall post this Emergency Contacts and Phone Numbers Table in a conspicuous location at the project site (next to the site map).

Key Person or Agency	Contact Name	Phone Number
1. EMT/ Ambulance	Monticello Ambulance	801-587-2116
2. Fire Department	Monticello Fire Dept.	587-2500
3. Hospital	San Juan Hospital	587-2116
4. Police	Monticello Police	801-678-2535
5. St. Mary's Air Life (Grand Junction)		303-344-2550
6. Geotech Office at Monticello		587-2153
7. Project Work Site	Brian Werle	Motel
8. Field Engineer/Foreman	Brian Werle	303-248-6471
9. Geotech Site H&S Coordinator	To Be Announced	
10. Technical Monitor	Brian Wilson	303-248-6495
11. Geotech H&S Supervisor	Syd Pincock	303-248-6708
12. Project Manager	Dave Scheuerman	
13. Geotech Office at Grand Junction		303-248-6073

If an emergency occurs, the succession of authority on the project site for the "Person-in-Charge" until relieved by the on-scene Emergency Director is as follows:

1) Geotech Field Engineer

2) Site Health and Safety Coordinator

3) Subcontractor Superintendent

4) Subcontractor Health and Safety Representative

The Subcontractor H&S Representative shall indicate on the "Site Map" the areas within the boundaries of the SUPPORT ZONE that are considered *Areas of Safe Refuge* to be used when evacuation is not possible.

10.2 Medical Emergency Procedures

EMERGENCY ACTION PRINCIPLES

These steps shall be taken by workers at the site, until the Person-in-Charge arrives, when a medical emergency occurs. These steps have been developed by the American Red Cross as "Emergency Action Principles."

1. Survey the scene (Is it safe?).
2. Do a PRIMARY SURVEY (Checking for the victim for unresponsivness).

   A - AIRWAY

   B - BREATHING

   C - CIRCULATION

3. Phone the appropriate EMERGENCY MEDICAL SERVICE (EMS) listed on the emergency contacts posting.
4. Perform a SECONDARY SURVEY (Interview, vital signs, head-to-toe exam).
5. Follow with the appropriate American Red Cross First Aid procedure for any follow-up care required until EMS arrives.

SIGNS AND SYMPTOMS OF EXPOSURE

The early warning signs, symptoms, and effects of exposure to the hazardous chemicals that are present at the project site are listed in Attachment 1 of this HSP.

MEDICAL EVACUATION PROCEDURES

The Subcontractor shall indicate the evacuation routes, travel time, and distance to the medical treatment Facility on the "Site Map" posted according the Section 8, Site Control. Indicate the following information concerning the treatment facility:

Travel Time From Site (Minutes)	Distance to Hospital (Miles)

When an injured person is contaminated, the person-in-charge shall decide what priority to give to medical treatment and decontamination. The decision aid shown below from Geotech Manual-103, *Environmental, Safety, and Health Procedures Manual*, Procedure 8.2, should be used when making this decision.

Treatment WITHOUT Decontamination

When it is determined that decontamination will not take precedence over the treatment of the injury notify OMP to inform the medical personnel of the contamination. If time does not permit involvement of the Medical Section the "Person-in-Charge" or the on-scene Emergency Director may inform the emergency medical personnel of the contamination.

10.3 Fire Response Procedure

The following steps shall be taken when a fire occurs at the project work site.

Small, localized fires should be handled using the appropriate fire extinguishers to bring the occurrence under control.

Uncontrolled fires shall be handled by the local Fire Department, workers should use the communication systems in place immediately to notify the local Fire Department of the fire.

If the fire involves material that could potentially release toxic gases all persons in the immediate vicinity shall be evacuated (sound the evacuation alarm), then the fire department shall be informed of the potential toxic gas hazard.

10.4 Notification and Reporting

The employee discovering the emergency is responsible for immediately reporting the situation by the most expeditious means available to the person in charge at the project site.

The "Person-in Charge" shall follow the requirements in Geotech Manual-103, *Environmental, Safety, and Health Procedures Manual*, Procedure 7.1, for notification and reporting.

10.5 Equipment

10.5.1 Emergency Communications equipment shall be arranged prior to commencement of work at the project site. Emergency response equipment is listed below:

FIRST AID KITS (SPECIFY TYPE)	LOCATION
Industrial	One per drill rig

FIRE EXTINGUISHERS (SPECIFY TYPE)	LOCATION
Type C	One per drill rig

The following Personal Protective Equipment is kept in reserve by the SHSC for use during an emergency:

PERSONAL PROTECTIVE EQUIPMENT		LOCATION
Type	Amount	
Respirator (Geotech will furnish) and cartridges	1 per person	Geotech's Monticello H&S Office (Abajo Building)

10.6 Emergency Alarms

The following alarm signals will be used at the project site to notify workers of an emergency situation:

Alarm	Device/sound pattern	Action to be taken
Evacuation	STEADY blast from an AIR HORN for THREE MINUTES	Evacuate the controlled area or Move to an area of safe refuge until evacuation can be completed.
Take Cover	INTERMITTENT blasts from an AIR HORN for THREE MINUTES	Move to an area of safe refuge until "ALL CLEAR" is sounded
All Clear	One blast from an AIR HORN for TEN SECONDS	Move to the SUPPORT ZONE with caution

11.0 SPILL CONTAINMENT PROGRAM

The spill containment program is required where major spills may occur during drum handling operations. Spill containment does not apply to this scope of work.

ATTACHMENTS 1

CHEMICAL DATA SHEETS

BIBLIOGRAPHY

1. Sittig,Marshall, *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, Second Edition; Noyes Publications, Park Ridge, NJ; 1985.

2. Sax, Lewis, *Dangerous Properties of Industrial Materials*, Seventh Edition; Van Nostrand Reinhold, NY, 1989.

3. *NIOSH Pocket Guide to Chemical Hazards*, U.S. Department of Health and Human Services, 1990.

4. *Chemical Hazard Response Information System (CHRIS)*, U.S. Department of Transportation, 1984.

5. *Threshold Limit Values and Biological Exposure Indices for 1989-1990*, American Conference of Governmental Industrial Hygienists, Cinncinnati, OH, 1991.

6. OSHA 3112, *Air Contaminants - Permissible Exposure Limits*, 29 Code of Federal Regulations 1910.1000

7. *Odor Thresholds for Chemical With Established Occupational Health Standards*, American Industrial Hygiene Association, Akron, OH, 1989.

ANTIMONY

CAS#: 7440-36-0RTECS: CC4025000 RCRA WASTE NUMBER:
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.5	-	-	-	-	-	80	-	0.25
NIOSH REL:	-	0.5(Skin)	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.5	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.50 - 5.00 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 5.00 - 25.0 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 25.0 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Respiratory system, cardiovascular system, skin, eyes

Silver-white lusterous metal

MF: Sb
MW: 121.8 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh,Abs,Ing,Contact)

Irritated nose,throat,mounth; coughing, dizzyness, nausea, vomiting, diarrhea, stomach cramps, insomnia, irritated skin, olfactory fatigue

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

ARSENIC

CAS#: 7440-38-2RTECS: CG0525000 RCRA WASTE NUMBER: N/A
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.01	-	-	-	0.002	-	-	-	0.005
NIOSH REL:	-	0.01	-	-	-	0.002	-	-	-	0.005
ACGIH TLV:	-	0.02	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.01 - 0.10 mg/M^3 - Half Face Air Purified w/ HEPA Cart.

> 0.10 - 0.50 mg/M^3 - Full Face Air Purified w/ HEPA Cart.

> 0.50 mg/M^3 - Full face Supplied Air/SCBA press. demand -or- positive press.

IARC-1 "Carcinogenic to Humans"
NCI/NTP-1 Carcinogen
NIOSH Potential Human Carcinogen
OSHA Regulated Carcenogen - 1910.1018

Target Organs: liver, kidneys, skin, lymph system

Silvery-grey, or tin-white brittle solid

MF: As
MW: 75 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS:(Inh,Abs,Ing,Contact)

Dryness of nasal passages, gastrointestinal problems, muscle spasms, vertigo, delirium, coma, fatique, hyperpigmentation, peripheral neuropath, anemia.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

BERYLLIUM

CAS#: 7440-4171RTECS: DS1750000 RCRA WASTE NUMBER:
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.002	-	0.025	-	0.005	-	10	-	0.001
NIOSH REL:	-	-	-	-	-	0.0005	-	-	-	-
ACGIH TLV:	-	0.002	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.002- 0.01 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 0.01 - 0.10 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 0.10 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

IARC-2A "Probably Carcinogenic to Humans"
NCI/NTP-2 Carcinogen
ACGIH-A2 Carcinogen

Target Organs: Lungs, skin, eyes, mucous membranes

Hard brittle grey-white solid

MF: Be
MW: 9.0 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: N/A

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

CADMIUM

CAS#: 7440-43-9RTECS: EU9800000 RCRA WASTE NUMBER: N/A
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.2	-	-	-	0.6	-	-	-	0.025
NIOSH REL:	-	-	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.05	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

IARC-2A "Probably Carcinogenic to Humans"
NCI/NTP-2 Carcinogen
ACGIH-A2 Carcinogen

Target Organs: Resparatory system, kidneys, prostate, blood.

Silvery-white, blue-tinged lusterous metal

MF: Cd
MW: 112 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh,Ing,)

Pulmonary edema, dyspnea, cough, tight chest, substantial pain, head, chills, muscle aches, nausous, diarrhaea, anosmia, emphysema, proteinuria.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

HEXAVALENT CHROMIUM

CAS#: 7440-47-3RTECS: CB4200000 RCRA WASTE NUMBER: N/A
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	-	-	-	-	-	-	-	-	0.025
NIOSH REL:	-	-	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.05	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

.PM

IARC-1 "Carcinogenic to Humans"
NCI/NTP-1 Carcinogen
ACGIH-A1 Carcinogen

Target Organs: Respiratory system

MF: Cr(IV)
MW: N/A SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS:(Inh,Ing,)

Histologic fibrosis of lungs

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

COPPER

CAS#: 7440-50-8RTECS: GL5325000 RCRA WASTE NUMBER:N/A

Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	1	-	-	-	-	-	-	-	0.5
NIOSH REL:	-	1	-	-	-	-	-	-	-	-
ACGIH TLV:	-	1	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 1.00 - 5.00 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 5.00 - 50.0 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 50.0 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Respiratory system, skin, liver, increased risk of wilsons disease, kidneys.

MF: Cu
MW: 63.5 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh,Ing,Contact)

Irritates mucous membrane, Pharynx, nasal perforation, eye irritation, metal taste, dermititas.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

HEXAVALENT CHROMIUM

CAS#: 7440-47-3RTECS: CB4200000 RCRA WASTE NUMBER: N/A

Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	-	-	-	-	-	-	-	-	0.025
NIOSH REL:	-	-	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.05	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

.PM

IARC-1 "Carcinogenic to Humans"
NCI/NTP-1 Carcinogen
ACGIH-A1 Carcinogen

Target Organs: Respiratory system

MF: Cr(IV)
MW: N/A SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS:(Inh,Ing,)

Histologic fibrosis of lungs

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

LEAD

CAS#: 7439-92-1RTECS: OF 7525000 RCRA WASTE NUMBER: N/A

Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.05	-	-	-	-	-	-	-	0.025
NIOSH REL:	-	0.15	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.1	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 - Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 - Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 - Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue.

A heavy ductile, soft grey metal

OSHA Regulated - 1910.1025

MF: Pb
MW: 207 SG: 11.34 VP: 0 mm IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS:(Inh,Ing,Contact)
Lassitude, insomnia, pallor, eye grounds, anorexia, weight loss, malnutrition, constipation, abdominal pain, colic, hypertension, anemia, gingival lead line, trem, paralysis.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

MERCURY

CAS#: 7439-97-6RTECS: OV4550000 RCRA WASTE NUMBER: N/A
Synonyms: Quicksilver

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.05	-	-	-	-	-	-	-	0.025
NIOSH REL:	-	0.05	-	-	-	0.1	-	28.0	-	0.025
ACGIH TLV:	-	0.05	-	-	-	-	-	-	-	0.025

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 - Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 - Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 - Full face Supplied Air/SCBA press. demand -or- positive press.

OSHA Skin notation

Target Organs:Skin,respiratory system, central nervous system, kidneys & eyes.

Appearance varies depending on the alkyl compound combined with.
MF: Hg
MW: N/A SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS:(Inh,Abs,Ing,Contact)

Coughing, chest pains, dyspnea, bronchitis, pneumonia, tremors, insomnia, irritability, indecision, headaches, fatigue, stomatitis, salivation, gastrointestinal disorders, anorexia, weight loss, proteincra, irritation of the eyes & skin.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

MOLYBDENUM

CAS#: 1314-62-1RTECS: YW2450000 RCRA WASTE NUMBER:P120
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	5	-	-	-	-	-	-	-	2.5
NIOSH REL:	-	-	-	-	-	-	-	-	-	-
ACGIH TLV:	-	5	-	-	-	-	-	-	-	2.5

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 5.00 - 50.0 mg/M^3 - Half Face Air Purified w/ HEPA Cart.

> 50.0 - 500 mg/M^3 - Full Face Air Purified w/ HEPA Cart.

> 500 mg/M^3 - Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: None

Dark grey or black powder, with metalic luster

MF: Mo
MW: 95.9 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING:N/A

GOGGLES: N/A

WASH: N/A

CHANGE: N/A

REMOVE: N/A

RECOMMENDED FIRST AID RESPONSE:

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

NICKEL

CAS#: 7440-02-0RTECS: QR5950000 RCRA WASTE NUMBER: N/A
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	1	-	-	-	-	-	-	-	0.5
NIOSH REL:	-	0.015	-	-	-	-	-	-	-	-
ACGIH TLV:	-	1	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 1.00 - 50 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 50 - 250 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 250 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

IARC-1 "Carcinogenic to Humans"
NCI/NTP-2 Carcinogen
ACGIH-A1 Carcinogen

Target Organs: Nasal cavities, lungs, skin

Lustrious silvery solid

MF: Ni
MW: 59 SG: 8.9 VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh,Ing,Contact)

Sensitization dermititas, allergic asthma, nasal cavities, pneumonitis.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

SELENIUM

CAS#: 7782-49-2RTECS: VS7700000 RCRA WASTE NUMBER:P120

Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.2	-	-	-	-	-	-	-	0.1
NIOSH REL:	-	0.2	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.2	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.20 - 1.00 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 1.00 - 10.0 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 10.0 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

IARC-2B "Probably Carcinogenic to Humans"

Target Organs: Upper respiratory system, eyes Skin, liver, kidneys, blood

MF: Se
MW: 193 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh, Ing, Abs, Contact)

Irritated eyes,nose,throat; headache, chills, fever, bronchitas, metalic taste, garlic breath

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING:N/A

GOGGLES: N/A

WASH: N/A

CHANGE: N/A

REMOVE: N/A

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

SILVER

CAS#:7440-224 RTECS:VW3500000 RCRA WASTE NUMBER:NA
Synonyms: N/A

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.01	-	-	-	-	-	-	-	0.005
NIOSH REL:	-	0.01	-	-	-	-	-	-	-	-
ACGIH TLV:	-	0.1	-	-	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.01 - 0.05 mg/M^3 - Half Face Air Purified w/ HEPA Cart.

> 0.05 - 0.50 mg/M^3 - Full Face Air Purified w/ HEPA Cart.

> 0.50 mg/M^3 - Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Nasal septum, skin, eyes

White lusterous solid

MF: Ag
MW: 107.9 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh,Ing,Contact)
Argyria, nasal septum, throat, skin irritation, ulceration, gastrointestinal.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

PROVIDE: Eyewash stations

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

THALLIUM

CAS#: 7440-28-0RTECS: XG3425000 RCRA WASTE NUMBER:
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.1(skin)	-	-	-		-	-	-	0.05
NIOSH REL:	-	0.1(skin)	-	-	-		-	-	-	-
ACGIH TLV:	-	0.1(skin)	-	-	-		-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.01 - 0.05 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 0.05 - 0.50 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 0.50 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Eyes, central nervous system, liver kidneys, GI tract, hair, body

Appearance varies depending on the specific compound

MF: Ti
MW: N/A SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh, Abs, Ing, Contact)

Nausea, diarrhia, abdominal pain

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: Daily if there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

NATURAL URANIUM

CAS#: 7440-61-1RTECS: YR3590000 RCRA WASTE NUMBER: N/A
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.05	-	0.6	-	-	-	-	-	0.025
NIOSH REL:	-	-	-	-	-	-	-	30	-	-
ACGIH TLV:	-	0.2	-	0.6	-	-	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 | - Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 | - Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 | - Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Skin, bone marrow, lymphatics

Silvery-white maliable, ductile solid

MF: U
MW: 238 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh,Abs,Ing,Contact)

Dermatitis, skin

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

VANADIUM PENTOXIDE

CAS#: 1314-62-1RTECS: YW2450000 RCRA WASTE NUMBER:P120
Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	0.05	-	-	-	-	-	-	-	0.025
NIOSH REL:	-	-	-	0.05(15MIN)		-	-	70	-	-
ACGIH TLV:	-	0.05	-	-	-	-	-	-	-	0.025

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 0.05 - 0.50 mg/M^3 |- Half Face Air Purified w/ HEPA Cart.

> 0.50 - 2.50 mg/M^3 |- Full Face Air Purified w/ HEPA Cart.

> 2.50 mg/M^3 |- Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Respiratory system, skin, eyes.

Yellow orange powder or dark gray flakes.

MF: V_2O_5
MW: 182 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS: (Inh, Abs, Contact)

Irritated eyes, green tongue, metal taste, irritates throat, cough, fine rales, wheeze, bronchitis, dyspnea, eczema.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: Wear appropriate equipment to prevent repeated/prolonged skin contact.

GOGGLES: When reasonable probability of eye contact exists.

WASH: Promptly when skin becomes contaminated.

CHANGE: If there is any possibility that clothing may become contaminated.

REMOVE: Immediately remove any wetted non-impervious clothing.

RECOMMENDED FIRST AID RESPONSE:

EYES: Immediately wash with large amounts of water(15min) no contact lenses should be worn when working with this chemical.

SKIN: Promptly wash contaminated skin with soap and water, if clothing breakthrough occurs promptly remove clothing and wash skin with soap and water. Get medical attention promptly.

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

INGESTION: If this chemical is swallowed get medical attention immediately.

ZINC OXIDE DUST

CAS#: 1314-13-2RTECS: N/A RCRA WASTE NUMBER: N/A

Synonyms: None

	TWA		STEL		CEIL		IDLH		ACTION LEVEL	
	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3
OSHA PEL:	-	10	-	-	-	-	-	-	-	5
NIOSH REL:	-	5	-	-	-	-	-	-	-	-
ACGIH TLV:	-	10	-	-	-	15	-	-	-	-

RESPIRATORY PROTECTION RECOMMENDATIONS ABOVE THE DESIGNATED ACTION LEVEL

> 10.0 - 50.0 mg/M^3 - Half Face Air Purified w/ HEPA Cart.

> 50.0 - 500 mg/M^3 - Full Face Air Purified w/ HEPA Cart.

> 500 mg/M^3 - Full face Supplied Air/SCBA press. demand -or- positive press.

Target Organs: Respiratory System

Fine white odorless particles

MF: ZnO_2
MW: 81.4 SG: N/A VP: N/A IP: N/A

ODOR THRESHOLD: N/A

SYMPTOMS:(Inh,Abs,Ing,Contact)

Metallic taste, dry throat, cough, chills, fever, tight chest, dysp., rales, reduced pulmonary function.

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS:

CLOTHING: N/A

GOGGLES: N/A

WASH: N/A

CHANGE: N/A

REMOVE: N/A

RECOMMENDED FIRST AID RESPONSE:

INHALATION: If large amount of chemical is inhaled, remove to fresh air; if breathing has stopped perform rescue breathing. Keep the affected person warm and at rest. Get medical attention as soon as possible.

ATTACHMENT 2

FORMS

SUBCONTRACTOR HEALTH & SAFETY PLAN ACKNOWLEDGEMENT SHEET

Subcontractor acknowledges receipt of this Health & Safety plan.

_____
Subcontractor Company Name

_____ _____/_____
Company Representative Signature Date

Lower Tier Subcontractors

_____
Subcontractor Company Name

_____ _____/_____
Company Representative Signature Date

Geotech acknowledges receipt of subcontractors Health & Safety Plan.

_____ _____/_____
Technical Monitor Signature Date

_____ _____
Manager. Operational
Health & Safety

Geotech review and approval of subcontractor's Health & Safety Plan.

_____ _____/_____
Signature Date

Lower Tier Subcontractors acknowledge recept of subcontractors Health & Safety Plan.

_____ _____/_____
Subcontractor Company Name Signature Date

_____
Authorized Person

_____ _____

_____ _____

WORKER/SUPERVISOR TRAINING CHECK LIST

EMPLOYEE NAME _____ TITLE _____

SITE NAME/ADDRESS _____ SITE/PHASE NUMBER _____

Briefly describe the worker/supervisor job description and responsibilities:

Based on the above job description this employee will require:

- _____ hours Hazardous Waste Site H&S Training & _____ day(s) of "OJT"
  40/24 3/1
- _____ require 8 hours of supervisory training
  will/will not

_____/_____
OHS Supervisor Date

SHSC SIGNATURE DATE

Hazardous Waste Site H&S Training _____/_____

Supervisory Hazardous Waste Site H&S Training _____/_____

Respiratory Protection Wearer Training _____/_____

Radiation Worker Training _____/_____

Hazard Communication Training _____/_____

Site-Specific Training(Pre-entry Briefing) _____/_____

Supervised Field Experience (OJT) _____/_____

Figure 2. Worker/Supervisor Training Checklist

Documentation of Supervised Field Training (SARA)

Name _____ SSN _____

Company _____ Employee No. _____

Job Title _____ Site _____

Date(s) 3-day OJT _____ 1-day OJT _____
HS 206 *HS 207*

Section I — Administrative Overview (checklist)

- ☐ Site medical surveillance requirements, location of medical/first aid facilities, and policy for reporting injuries or emergencies
- ☐ Identification of individuals responsible for site health and safety
- ☐ Review of applicable sections of the site health and safety plan. State location of applicable procedures or regulations, including 29 CFR.
- ☐ Review of site emergency procedures including alarms, communication, evacuation routes and assembly areas. Discuss the site's "stop work" policy.
- ☐ Hazard communction for hazardous materials present on the site, including the type, form, and location of such materials. Include location of MSDS.
- ☐ Site tour with identification of hazards, fire extinguishers, emergency and personal protective equipment, decontamination and monitoring stations, potable water, sanitation facilities and designated break areas.

_____ / _____ _____ / _____
Trainee *Date* *Supervisor* *Date*

UNC 1757
7/90

Figure 9.3–1. Documentation of Supervised Field Training (SARA), Form Geotech 1757 (Rev. 0), Page 1

Section II — Field Training

Description of Hazards Anticipated or Encountered

Detailed Description of Duties Performed

Tools, Equipment or Instruments Used

Level of Protection Required (Note: Protective clothing must be actually worn. Discussion of use is insufficient.)

I certify that the information provided accurately represents the field training that occurred during the period noted.

Trainee	/ Date	Supervisor (individual who conducted the field training)	/ Date

Figure 9.3–1 (continued). Documentation of Supervised Field Training (SARA), Form Geotech 1757 (Rev. 0), Page 2

ATTACHEMENT 3

DRILLING HEALTH & SAFETY PLAN

January 1991

CHEM-NUCLEAR GEOTECH, INC.
DRILLING HEALTH AND SAFETY PLAN
For Operation of Small Auger, Rotary and Coring Rigs

Introduction

All work under this subcontract shall be conducted in accordance with the established safety regulations of Occupational Safety and Health Administration (OSHA), U. S. Department of Energy (DOE), and other applicable Federal, State, County, and City regulations. The full set of OSHA and DOE Standards are available for inspection and/or questions at the Chem-Nuclear Geotech, Inc. Health, Safety, and Security Section, Grand Junction, Colorado. Compliance inspections will be made by Chem-Nuclear Geotech, Inc. Health, Safety, and Security personnel.

A formal notice of employee rights and obligations is a vital part of this program and must be posted near the job site. The OSHA poster is required to be posted and shall be accessible by all employees.

The safety of all personnel takes priority over all other aspects of the drilling project. All personnel, including Chem-Nuclear Geotech, Inc., Subcontractor and site visitor(s) shall receive daily safety instruction and information regarding potential safety hazards at the site. Such daily training will be documented in the project records. All visitors will be escorted by a Chem-Nuclear Geotech, Inc. representative during their presence at the drilling site(s). **Department of Energy, or Chem-Nuclear Geotech, Inc. personnel will suspend all drilling operations when an unsafe practice or condition is observed. Drilling will not proceed until the unsafe practice or condition is corrected. The Subcontractor shall not be compensated for efforts required to correct any unsafe act or unsafe condition created by his actions.**

The subcontractor is responsible for safe operations of his subcontractors, who are also subject to these rules and regulations. Any injury/illness that occurs as a direct result of work being performed under this subcontract requires an accident report covering the incident. The accident report is to be submitted to Chem-Nuclear Geotech, Inc. Health, Safety, and Security within one working day of the accident.

The subcontractor must have a written and functional safety program to protect site workers, the general public, and the environment. Before work commences, a safety management program and implementation plan which includes, but is not limited to the following, must have been reviewed and approved in writing by Chem-Nuclear Geotech, Inc. Health Safety and Security. The scope of the program will be determined by the size of the project and the hazards of the job. The minimum areas to be covered are as follows:

1. **The Drill Rig Operator:**

   - The drill rig operator should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter for first importance.

- The drill rig operator shall be the leader in using proper personal safety gear and set an example in adhering to the rules and regulations that are set forth for the project.

- The drill rig operator shall enforce the use of proper personal protective safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.

- The drill rig operator and crew should understand that proper maintenance of tools and equipment and general "housekeeping" on the drill rig will provide the environment to promote and enforce safety.

- The drill rig operator shall inspect the rig to insure that the required safety devices, e.g. safety engine shut-down switches, are installed and are functional. The drill rig operator shall inspect the rig to insure that applicable safety placards are installed at potential safety hazard locations as recommended by the manufacturer.

- Before drilling is started with a particular drill, it will be assured that the operator has had adequate training and is thoroughly familiar with the drill rig, its controls, its capabilities and operating parameters.

- The drill rig operator will inspect the drill rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged pressure gauges and pressure relief valves.

- The drill rig operator will check and test all safety devices such as emergency shut-down switches at least daily and preferably at the start of a drilling shift.

- The drill rig operator shall check that all gauges, warning lights and control levers are functioning properly and listen for unusual sounds on each starting of an engine.

- The drill rig operator shall assure that all new drill rig workers are informed of safe operating practices on and around the drill rig. The drill rig operator should assure that each new employee understands the safety requirements and document the new employee's acceptance of the requirements.

- The drill rig operator shall observe the mental, emotional and physical capability of each worker to perform the assigned work in a proper and safe manner.

- The drill rig operator shall assure that there is a fully stocked first-aid kit and OSHA/DOT approved fire extinguisher on the rig.

- The drill rig operator (and as many crew members as possible) shall be well trained and capable of using first-aid kits, fire extinguishers and all other safety devices and equipment.

- The drill rig operator will maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police,

hospitals, etc.) and inform other members of the drill crew of the existence, location and proper use of the list.

2. **Individual Protective Equipment**

- o Clothing will be close fitting but comfortable, without loose ends, straps, draw strings or belts or otherwise unfastened parts that might catch on some rotating or moving component of the drill.

- o Assure that personal protective equipment provided meets NIOSH/ANSI specifications.

- o Safety Head Gear. Safety hats (hard hats) will be worn by everyone working or visiting at or near a drill site.

- o Safety Shoes or Boots. Safety shoes or boots should be worn by all drilling personnel and all visitors to the drill site that observe drilling operations within close proximity of the drill rig.

- o Safety Glasses. All drilling personnel and visitors to the drill site are required to wear approved safety glasses or goggles while the drill rig is in operation or other drilling functions are being performed. Presciption glasses shall be an approved safety type or goggles must be used.

- o Gloves. All drilling personnel shall wear gloves for protection against cuts and abrasion which could occur while handling wire rope or cable and from contact with sharp edges and burrs on drill rods and other drilling or sampling tools.

- o Other Protective Equipment. For some drilling operations, the environment or regulations may dictate that other protective equipment be used. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically or radiologically contaminated ground, special protective equipment and clothing may and probably will be required.

3. **Housekeeping On and Around the Drill Rig**

- o Suitable storage locations should be provided for all tools, materials and supplies so that tools, materials and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.

- o Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.

- o Pipe, drill rods, casing, augers and similar drilling tools should be orderly stacked and secured on racks or sills to prevent spreading, rolling or sliding.

- o Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.

- Work areas, platforms, walkways, scaffolding and other access ways should be kept free of materials, debris and obstructions and substances such as ice, grease or oil that could cause a surface to become slick or otherwise hazardous.

- Keep all hand controls, control linkages, warning and operation lights and lenses free of excess oil, grease, ice, or other foreign material.

- Do not store gasoline in any portable container other than a nonsparking, red container with a flame arrester in the fill spout and having the work "gasoline" easily visible.

- All gasoline engines, when operated in fire danger areas, will be equipped with exhaust spark arresters.

4. **Maintenance Safety**

- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidental starting of an engine during maintenance by removing or tagging the ignition key or ignition control.

- Always block the wheels or lower the leveling jacks or both and set hand brakes before working under a drill rig.

- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance.

- Never weld or cut on or near a fuel tank.

- Do not use gasoline or other volatile or flammable liquids as a cleaning agent on or around a drill rig.

- Replace all caps, filler plugs, protective guards or panels and high pressure hose clamps and chains or cables that have been removed for maintenance before returning the drill rig to service.

- All persons shall remain clear of rotating equipment.

- All pressure hose connections shall be secured with safety chains or clamped to prevent whipping in the event of a break.

- Each crew member shall report promptly any worn, defective, or unsafe items which is observed.

- Pipelines, tanks, and other storage facilities (for fuel, oil, gas, mud, soap, etc.) shall be kept from leaking.

5. **Safe Use of Hand Tools**

- When a tool becomes damaged, either repair it before using it again or remove from service.

- Keep all tools cleaned and stored in an orderly manner when not in use.

- Never use pipe wrenches in place of a rod holding device.

- Replace hook and heel jaws when they become visibly worn.

- When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be injured between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

6. **Clearing the Work Area**

Prior to drilling, adequate site clearing and leveling should be performed to accommodate the drill rig and supplies and provide a safe working area. Drilling should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions or potential fire hazards.

7. **Start Up**

- All drill rig personnel and visitors should be instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.

- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct nonactuating positions and the cathead rope is not on the cathead before starting a drill rig engine.

8. **Safety During Drilling Operations**

- Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.

- Before raising the mast (derrick) look up to check for overhead obstructions.

- Before raising the mast (derrick), all drill rig personnel (with exception of the operator) and visitors should be cleared from the areas immediately to the rear, front and the sides of the mast.

- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up.

- The operator of a drill rig should only operate a drill rig from the position of the controls. The operator shall remain at control station at all times when rig is in operation.

- Throwing or dropping of tools should not be permitted.

- If it is necessary to drill within an enclosed area, make certain that exhaust fumes are conducted out of the area.

- All unattended boreholes must be adequately covered or otherwise protected to prevent drill rig personnel, site visitors or animals from stepping or falling into the hole. All open boreholes should be covered, protected or backfilled adequately and according to local or state regulations on completion of the drilling project.

- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on the ladder.

- When climbing to a derrick platform that is higher than 20 feet (6 m), a safety climbing device shall be used. Anyone working on a derrick board or platform shall wear a safety belt or harness securely fasten by a safety lanyard.

- When working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block. Only rack one pipe stand at a time.

- Loose tools and similar items should not be left on the derrick platform or on structural members of the derricks.

- A derrick platform over 4 feet (1.2 m) above ground surface should have toe boards and safety railing that are in good condition.

- Before manually lifting any object, make sure that the load is within your personal lifting capacity.

- Personnel shall not ride the hoisting line, catline, traveling block, the traveling block hook, the elevators, or any equipment suspended therefrom as a means of ascending or descending to or from the derrick.

- Assure that equipment furnished for use on this site is maintained in safe operating condition and operated by qualified operators. Cranes, pressure vessels, and large earth moving equipment shall have valid certificates and logs of inspection and maintenance.

- Assurance that the location of the nearest phone or radio to contact emergency services shall be prominently posted and that emergency preparedness actions are recognized and communicated to personnel.

- Safety meetings shall be held to inform employees and other subcontractors of progress of work, changes, hazards anticipated and inspection deficiencies or good examples of employee protection. A daily toolbox meeting assures that good communications is maintained. A record must be kept of the subject, attendance taken of the meeting, and suggestions made.

- Horseplay, practical jokes, and scuffling are forbidden at all times on and around the drill rig.

9. **Overhead and Buried Utilities**

- Overhead and buried utilities shall be located, noted and emphasized on all boring location plans and boring assignment sheets.

- When overhead electrical power lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.

- Watch for sagging power lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to lift or raise the lines or deenergize (turn off) the power.

- An observor shall be posted at sufficient distance from the rig to adequately monitor for safe clearance during the raising and lowing of the rig mast when operating in the vicinity of overhead powerlines or other overhead obstructions.

- Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 feet (6 m). **Geotech policy for operating boomed or drilling equipment with mast, tower or derrick in proximity of overhead powerlines requires that a minimum clearance of 20 feet, plus the length of the boom or rig mast as mearsured in the horizontal plane, be maintained from any power line. The Geotech 20-foot minimum clearance requirement can only be reduced to the OSHA requirement with approval of the Geotech technical monitor or designee. Any such approval will be granted only after a thorough inspection, which must determine that no safety hazard will be created or will exist by the application of the OSHA requirement. Any such variance will be fully documented by the grantor. In addition, a GEOTECH SAFE WORK PERMIT must be issued before any work is performed under the variance.**

- The mast shall not be raised or lowered during high wind conditions or when visibility is restricted. Hydraulic systems shall be checked prior to lowering the mast.

10. **Safe Use of Electricity**

- All wiring should be installed using high quality connections, fixtures and wire, insulated and protected with consideration of the drilling environment. Makeshift wiring and equipment should not be permitted.

- All lights positioned directly above working areas should be enclosed in cages or similar enclosures to prevent loose or detached lamps or vaportight enclosures from falling on workers.

- Electrical cables should be guarded and located to prevent damage by drilling operations or by the movement of personnel, tools or supplies.

- All plug receptacles should be the three-prong, U-blade, grounded type and have adequate current carrying capacity for the electrical tools that may be used.

- All electric tools should have three-prong, U-blade, ground wire plugs and cords.

- Do not use electrical tools with lock-on devices.

- All electrical welders, generators, control panels and similar devices should be adequately grounded.

- Control panels, fuse boxes, transformers and similar equipment should have a secure, protective enclosure. Only weather-proof boxes and fittings should be used for exterior application.

- Poles used to hold wiring and lights should not be used for any other purpose.

- Power should be turned off before changing fuses or light bulbs.

- Only qualified electricians will work on electrical devices or on electric lines, do not go near them.

- All portable electrical equipment used by personnel should have GFCI protection.

11. **Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware**

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for: abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion and damage to lifting hardware.

- All manufactured end fittings and connections shall be installed ac cording to the manufacturer's instructions and loaded according to the manufacturer's specifications. This would include cable clamps and thimbles.

- If a ball-bearing type hoisting plug is used to hoist drill rods, the bearings should be inspected and lubricated daily to assure that the hoisting plug rotates freely under load.

- Wire ropes must be properly matched with each sheave. Non-rotating wire rope is suggested for light rig application.

- Minimize shock loading of a wire rope - apply loads smoothly and steadily.

- Avoid sudden loading in cold weather.

- Never use frozen ropes.

- Protect wire rope from sharp corners or edges. Avoid "pile-up" or uneven spooling of wire rope.

- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment tackle being used. Never exceed this limit.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles and other lifting aids.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of new wire rope, first lift a light load to allow the wire rope to adjust.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body or feet of any personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.

12. **Safe Use of Cathead and Rope Hoists**

- Keep the cathead clean and free of rust and oil and/or grease.
- Check the cathead periodically, when the engine is not running, for rope wear grooves.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg, or any other part of your body.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a load and that can be safely released.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- The cathead operator must be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

13. **Safe Use of Augers**

The following general procedures should be used when starting a boring with continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM.

- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.

- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.

- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.

- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.

- An auger guide can facilitate the starting of a straight hole through hard ground or pavement.

- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench or any other tools during rotation.

- Whenever possible, use tool hoists to handle auger sections.

- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.

- Never allow feet to get under the auger section that is being hoisted.

- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever. A minimum of 18 inches clearance shall be maintained between personnel, clothing, footwear and other personal protrudences and the rotating augers, kellys, heads, drillrod or other rotating components of the drill rig.

- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.

- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

- Auger speed shall be that speed necessary for pentration and cuttings removal. High speed auger rotation shall not be used for penetration

or cuttings removal unless approved by the on-site Chem-Nuclear Geotech, Inc. supervisor. In such case, all unnecessary personnel will be removed from the rig operating area.

14. **Safety During Rotary and Core Drilling**

- o Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- o Pressure relief values will be installed and operable on all circulation systems.
- o Drill rod chuck jaws should be checked periodically and replaced when necessary.
- o Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.
- o Drill rods should not be held or lowered into the hole with pipe wrenches.
- o In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- o When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use hands to clean drilling fluids from drill rods.
- o If work must progress over a portable drilling guide (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- o Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

15. **Off-Road Movement**

- o Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gulleys, ruts and similar obstacles.
- o Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
- o Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts and mountings.
- o Use caution when traveling side-hill, Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).

16. **Hazardous Materials and Waste**

- The subcontractor shall assure material safety data sheets (MSDS) are provided for all hazardous materials and personnel are trained in accordance with 29 CFR 1910.1200.

- Chemicals, corrosives, etc. shall be properly labeled, placarded and stored.

17. **Subcontractor Statement of Understanding**

The Subcontractor and each Subcontractor employee working on this project is required to read and fully understand the provisions of this Plan. The Subcontractor and each Subcontractor employee working on this project shall sign the attached STATEMENT OF UNDERSTANDING before commencing any work on this project.

UNC GEOTECH DRILLING SAFETY AND HEALTH PLAN

STATEMENT OF UNDERSTANDING

I, the undersigned, am an employee of the Subcontractor, doing business as, _____, have received and have read the Chem-Nuclear Geotech, Inc. Drilling Health and Safety Plan. Further, I understand all provisions of the Plan.

	Name (please print)	Signature	Date	Position
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

ATTACHMENT 4

ABBREVIATIONS

ABBREVIATIONS

AEDE	Annual Effective Dose Equivalent
ANSI	American National Standards Institute
CEDE	Cumulative Effective Dose Equivalent
CFR	Code of Federal Regulations
DAC	Derived Air Concentration
dBA	Decibels "A" Scale
dpm	Desentigrations per minute
EMS	Emergency Medical System
ES&H	Environmental Health & Safety
F	Farenheit
HSP	Health & Safety Plan
H&S	Health and Safety
mg/m^3	Milligrams per cubic meter
Micro R/hr	Micro-Rem per hour
MRAP	Monticello Remedial Action Project
Mrem/hr	Milli-Rem per hour
OH&S	Operational Health & Safety
OJT	On the Job Training
OMP	Occupational Medial Program
OSHA	Occupational Safety and Health
PCB	Polychloronated Biphenols
pCi/g	PicoCurries per gram
PPE	Personal Protective Equipment
PPM	Parts per million
Ra-226	Radium-226
RI/FS	Remedial Investigation Feasibility Study
ROTA	Record of Training Attendance
RWP	Radiation Work Permit
R&ES	Radiological and Environmental Safety
SARA	Superfund Amendments and Reauthorization Act
SFMP	Surplus Facility Management Program
SHSC	Site Health and Safety Coordinator
TBA	To Be Announced
TLD	Thermoluminescent Dosimeter
TLV	Threshold Limit Value
TWA	Tine-Weight Average
U (Uranium)	Uranium

APPENDIX E

QUALITY ASSURANCE REQUIREMENTS

QUALITY ASSURANCE REQUIREMENTS

1.0 Quality Assurance/Quality Control Plan

A plan, or equivalent for controlling the quality of services furnished for this subcontract will be prepared and submitted to Geotech with the Offeror's work plan. The plan will be used during performance under this subcontract and is subject to approval and audit by Geotech. The plan will describe the Offerors organization responsibilities and control methods to be used during performance under this subcontract. The plan will address:

- Organization
- Human and Physical Resources
- Procedural Systems
- Management Systems
- Laboratory Testing
- Field Testing and Inspection
- Sampling Capabilities and Controls

The plan or information provided will be evaluated to the requirements of ASTM Standard D-3740-88 "Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction" and appropriate metals and organic sampling procedures.

2.0 Pre-Award Surveys

When deemed necessary by the Buyer, Geotech will conduct a Pre-award Survey of a prospective Offeror's technical, quality assurance, production, laboratory, or financial capability. Evaluation of the quality assurance program or plan for assuring the quality of services to be provided by the Offeror, including subcontractors, may include, but will not be limited to test controls, measuring and test equipment calibration controls, process controls, personnel qualifications, and test sample storage and handling. Offeror found deficient or inadequate may be considered unacceptable and the evaluation used as a basis to deny award of the contract.

3.0 Rights of Access

Geotech reserves the right to verify the quality of any work performed under this contract at the Offeror's facilities, including the facilities of subcontractors. Access to subcontractor facilities will be requested through the Offeror. Verifications may be performed jointly with the Offeror.

4.0 Subcontracting

When the Offeror subcontracts any part of this contract, with the exception of raw materials and shelf items, the Offeror is required to impose the applicable technical and quality requirements on the subcontractor. Geotech will be notified of the subcontractors and the scope of the subcontracted work.

The identified subcontractors will be subject to approval by Geotech before the start of subcontract work. Approval will be based on the subcontractor's capability to meet the applicable technical and quality requirements of this contract.

Unpriced purchase orders to approved subcontractors will be submitted to Geotech on request.

5.0 Report of Discrepancies

The Offeror will report to the buyer, by a documented system, information that identifies and provides for the disposition of services, data, or items that do not meet the requirements of the procurement documents. The report(s) will contain (1) identification and evaluation of discrepant items, services, or data, (2) submittal of a discrepancy notice to Geotech with the Offeror recommended dispositions (use-as- is, retest or reject), (3) provisions for Buyer approval of the recommended dispositions, and (4) methods for verification of the implementation of the disposition. The report will also include the Offeror recommended disposition, technical justification, requirements violated, and actual condition or discrepancy.

QUALITY ASSURANCE SUBMITTALS

1.0 With Work Plan

1.1 Quality Assurance/Quality Control Plan or equivalent.

1.2 The Seller's organization chart and the names and resumes of key individuals who would be utilized or have responsibilities during performance of work under this contract.

1.3 A discrepancy reporting system, including an example of the report form.

1.4 A list of any proposed subcontractors, and the proposed scope of work. When appropriate, include a history of past contract associations and the scope of work provided by the subcontractor.

1.5 A history of any similar work performed during the past 3 years. The history will include the names of client technical and quality assurance contacts and their telephone numbers whenever possible.

2.0 Before Start of Work

2.1 Identification of the individual who will serve as the Quality Assurance contact for this contract.

2.2 A list of subcontractors and scope of work (if different from those listed in the proposal).

3.0 During Contract Performance

3.1 Any discrepancy reports having an effect on contracted work.

4.0 At Completion of Contract

4.1 Copy of all discrepancy reports.

APPENDIX F

REPORT OUTLINE EXAMPLE

This outline is contained in the Final Report
South Site Hydrogeologic and Geotechnical Investigation
Monticello Remedial Action Project
Monticello, Utah

Volume 1
May 1990

Note: This outline is included only to identify the level of detail desired.

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APPENDIX G

PREVIOUS CHARACTERIZATION DATA

This appendix consist of excerpts from

DATA COLLECTION FOR ENGINEERING
FOR THE URANIUM TAILINGS SITE
AND ADJACENT PERIPHERAL PROPERTIES,
MONTICELLO, UTAH

September, 1986

by

Bendix field Engineering Corp.

Note: This is presented for informational purposes only.

GJ-51

Monticello Remedial Action Project

DATA COLLECTION FOR ENGINEERING FOR THE URANIUM MILL TAILINGS SITE AND ADJACENT PERIPHERAL PROPERTIES, MONTICELLO, UTAH

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Bendix Field Engineering Corporation
Grand Junction, Colorado

September 1986

Prepared for
U.S. Department of Energy
Surplus Facilities Management Program
Richland, Washington

Under Contract No. DE-AC07-76GJ01664
U.S. Department of Energy
Grand Junction Projects Office
Grand Junction, Colorado

1.0 INTRODUCTION

This geotechnical and radiologic characterization of the mill area, mill tailings areas, and peripheral properties surrounding the inactive uranium millsite at Monticello, Utah, was conducted by Bendix Field Engineering Corporation (Bendix) for the U.S. Department of Energy (DOE) under the Surplus Facilities Management Program (SFMP). The data presented in this report are supplementary to other characterization studies performed and are in support of engineering design for remedial activities.

A Quality Assurance Field Readiness Review was conducted by Bendix Field Engineering Corporation on 27 August 1985 at the DOE Grand Junction Projects Office. Fieldwork was conducted at the Monticello, Utah, site from 3 to 13 September 1985 and from 4 to 15 November 1985.

2.0 BACKGROUND

For a detailed description of the Monticello millsite, including location, history, and current geologic and hydrologic conditions, refer to the Monticello Remedial Action Project Site Analysis Report (Abramiuk and others, 1984). For additional information related to the properties surrounding the millsite, refer to the Radiologic Characterization of the Peripheral Properties Adjacent to the Monticello, Utah, Millsite (Marutzky and others, 1985). For additional information related to moisture and mineral content of the tailings refer to the Monticello, Utah, Mill Tailings Drilling and Sampling Project Survey Analysis, Internal Document (Bendix Field Engineering Corporation, 1980).

2.1 LOCATION

The 78-acre Monticello millsite (see Figure 1) is located just southeast of the City of Monticello in San Juan County, Utah. It lies in Section 36, Township 33 South, Range 23 East, and Section 31, Township 33 South, Range 24 East (Salt Lake Meridian). Millsite elevations range from 6990 feet at the northwest corner to 6820 feet at the southeast corner.

The mill area covers approximately 11 acres and the tailings-impoundment area covers the remaining 67 acres. An estimated 182,000 cubic yards (yd^3) of contaminated material have been identified in the former area, and 1,428,000 cubic yards (yd^3) of tailings and contaminated soil in the tailings-impoundment area. The tailings are contained in four piles: the Carbonate Tailings Pile covers 7.7 acres, the Vanadium Tailings Pile covers 3.7 acres, the East Tailings Pile covers 16.6 acres, and the Acid Tailings Pile covers 9.2 acres. All of the piles currently have a vegetative cover consisting of alfalfa and mixed native grasses.

During the period of mill operation, land to the north, west, and south of the tailings area was leased for the stockpiling of ore. These ore-stockpile areas remain contaminated, and contain the majority of the estimated 293,000 yd^3 of peripheral property material that will be excavated as part of this project.

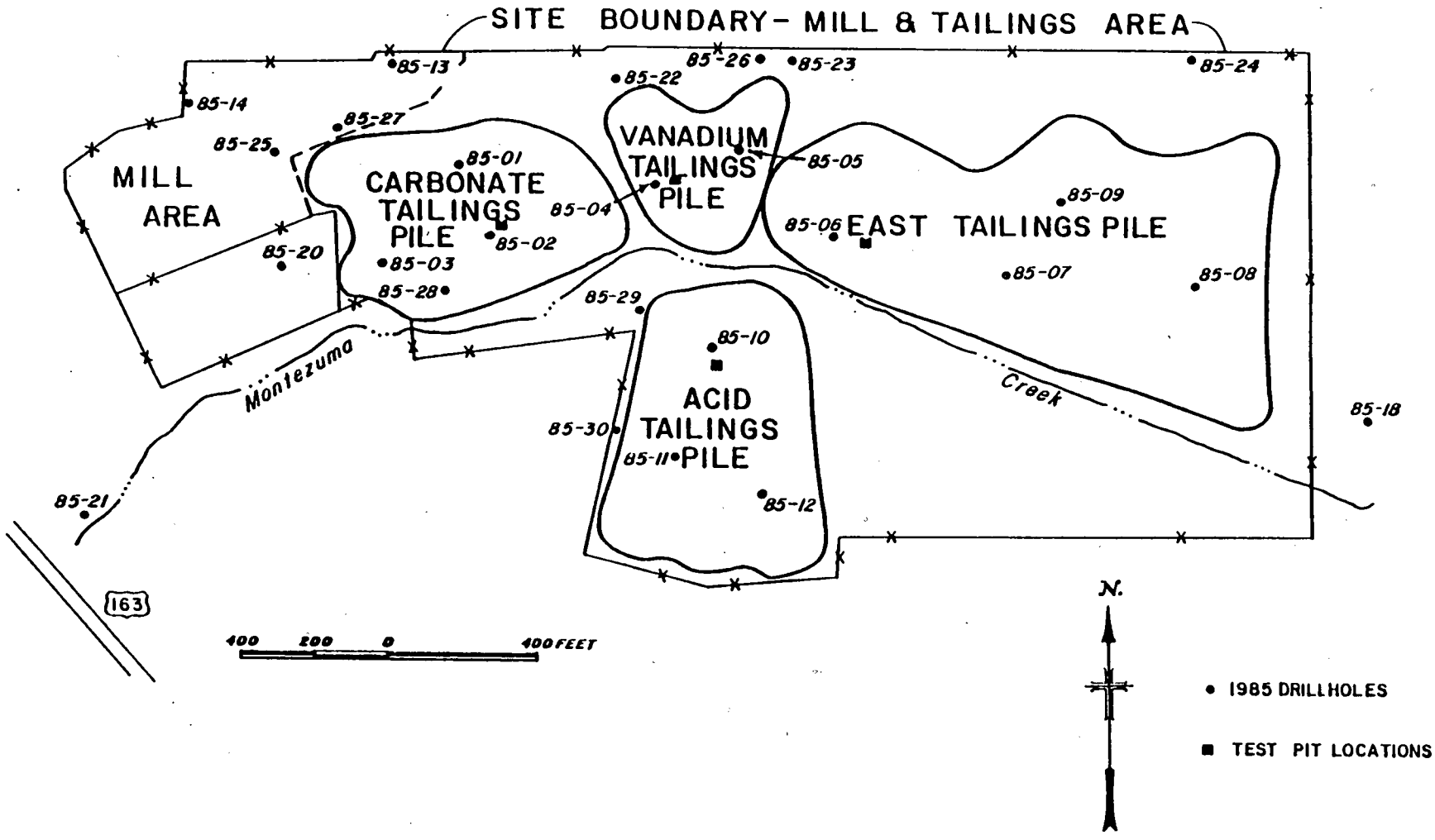


Figure 1. Borehole and Tailings Pile Locations at the Monticello, Utah, Millsite

The total area of the Monticello peripheral properties encompasses approximately 1 square mile surrounding the millsite and tailings piles, excluding the residential properties to the northwest. Peripheral area elevations range from 6700 to 7000 feet above sea level. An estimated 293,000 yd^3 of contaminated material has been identified on the peripheral properties.

The peripheral property areas north and east of the millsite are used mainly for agricultural purposes (i.e., grazing, stockponds, and alfalfa fields) and include some residences.

West of the millsite, thick oak brush and wild roses cover most of the area from Highway 163 to the west fence, except for the ore-storage and ore-buying area in the northwest and the former housing area to the southwest.

The area south of the millsite is used for grazing, and is otherwise undisturbed. The dominant vegetation comprises cedar and pine trees and oak brush, except in the south ore-storage area where the original topsoil was removed some years ago; vegetation in this latter area consists of smaller plants such as sagebrush.

A potential borrow area for obtaining cover material for the tailings piles was included as part of this study, and is located approximately 1 mile east of the millsite.

2.2 PROCEDURES

The geotechnical and radiologic characterization of the site was performed in accord with protocols established in the UMTRA (Uranium Mill Tailings Remedial Action) Program Site Characterization Radiologic Field Measurements Procedures Manual, (Bendix Field Enginering Corporation, 1985b), specifically the following procedures:

- Section 4.1, 'Spectral Gamma (KUT) Borehole Logging,' Rev. No. 03, dated 14 June 1985.
- Section 4.3, 'Portable Total-Count Logging of Augered Holes,' Rev. No. 02, dated 14 June 1985.
- Section 5.2, 'Split-Barrel Sampling,' Rev. No. 03, dated 14 June 1985.
- Section 5.3, 'Soil Identification and Classification,' Rev. No. 02, dated 14 June 1985.
- Section 5.4, 'Test-Pit Sampling,' Rev. No. 02, dated 14 June 1985.
- Section 5.6, 'Shelby Thin-Wall Tube Sampling,' Rev. No. 01, dated 14 June 1985.

2.3 GENERAL

A total of 22 auger boreholes (85-1 through 85-22) were drilled: 12 boreholes were drilled in the tailings piles, 3 boreholes in the mill area, 2 boreholes in the borrow area, and 5 boreholes in the peripheral properties. Borehole locations are presented in Table 1 and are shown in Figure 1.

All boreholes were drilled and downhole logged for determination of radium-226 concentration. If downhole logging indicated the presence of Ra-226 contami-

Table 1. Borehole Locations at the Monticello Millsite

Borehole Number	Grid Coordinates		Surface Elevation (ft)
	North	East	
85-01	11060.0	21250.0	6897.2
85-02	10880.0	21300.0	6898.5
85-03	10882.0	21011.0	6871.5
85-04	11090.0	21740.0	6875.9
85-05	11150.0	21900.0	6874.6
85-06	10840.0	22250.0	6850.9
85-07	10750.0	22660.0	6848.6
85-08	10750.0	23140.0	6849.9
85-09	11001.0	22850.0	6850.3
85-10	10430.0	21890.0	6896.8
85-11	10180.0	21800.0	6896.1
85-12	10090.0	22001.0	6897.4
85-13	11326.5	21025.5	6934.7
85-14	11270.0	20400.0	6982.4
85-15	10115.0	28534.5	6841.5
85-16	9798.0	29447.0	6820.0
85-17	10035.0	25005.0	6782.2
85-18	10365.0	23605.0	6803.8
85-19	9360.0	21405.0	6937.2
85-20	10760.0	20705.0	6871.3
85-21	10160.0	20205.0	6884.8
85-22	11285.5	21720.5	6880.0
85-23	11294.0	22143.5	6877.9
85-24	11276.5	23107.5	6868.4
85-25	11106.5	20691.0	6912.1
85-26	11301.5	21967.5	6880.5
85-27	11165.5	20934.5	6905.6
85-28	10795.0	21085.0	6876.2
85-29	10603.5	21652.0	6866.0
85-30	10175.0	21550.0	6888.0

nation in excess of 15 picocuries per gram (pCi/g) at the bottom of the hole, drilling and logging continued at 5-foot increments until a 15 pCi(Ra-226)/g limit was reached.

At least five 3-inch oversize-barrel samples were collected from each borehole in the tailings piles, mill area, and borrow area. One 3-inch outside diameter (OD) Shelby tube sample, sealed and capped, was also collected from each borehole in the tailings piles. Lithologic logs of borehole split-barrel samples were completed using methods and procedures of the Unified Soil Classification System and American Society for Testing Materials (ASTM) standard penetration tests.

Hydrogeologic information was obtained by coring eight additional boreholes (85-23 through 85-30). These boreholes were drilled along the boundary of the

millsite and continuous NX* core samples were obtained in the bedrock. In-situ permeability tests were performed in five of the boreholes. Figure 1 shows the location of boreholes on the millsite property. Plate 1 shows the location of all the boreholes drilled during the geotechnical and radiologic characterization.

Test pits were dug at each borehole location in the peripheral property area. Two 5-gallon soil samples were obtained from each test pit. One test pit was also dug with a backhoe in each of the four tailings piles to a maximum depth of 15 feet. Four bulk samples were collected from each test pit: one surface (2-foot depth) sample, one sand tailings sample, one slime sample, and one sand/slime mix sample.

Sediment samples from the streambed of Montezuma Creek, downstream from the site, were collected from six locations in 5-gallon buckets. Locations of the streambed samples are listed in Table 2.

Table 2. Location of Test Pits in the Montezuma Creek Streambed

Station	Grid Coordinates	
	North	East
ZERO	9261.5	27443.0
+1000	8823.5	28668.0
+2000	8602.5	29624.0
+3500	8150.0	30876.0
+5000	7714.0	32575.5
+6500	7781.0	34011.0

2.4 ANALYSIS OF SAMPLES

The following analyses were performed on the collected soil samples:

- Dry-Bulk Density
- Radon Emanation
- Radium-226 Concentration in Soil
- Moisture Content
- American Society for Testing Materials (ASTM) D422 Particle Size
- ASTM D698-78 Moisture-Density Relations (Proctor)
- ASTM D854-83 Specific Gravity of Soils
- ASTM D2325-68 or 3152-72 Capillary-Moisture Relationships
- ASTM D2434-68 Constant-Head Permeability
- ASTM D2435-80 One-Dimensional Consolidation
- ASTM D2487-83 Classification of Soils
- ASTM D4318-83 Atterberg Limits (liquid limit, plastic limit, and plasticity index)

*NX = outside diameter 3-1/2 inches, inside diameter 3-3/16 inches.

A total of 83 split-barrel, 12 Shelby tube, and 16 test-pit samples were collected in the tailings piles. Ten split-barrel samples were collected in the mill area, and 11 split-barrel and 10 test-pit samples were collected from the peripheral properties. A total of 10 samples were collected at the potential borrow site: 7 split-barrel, 2 test-pit, and 1 Shelby tube. Six test-pit samples were collected from the streambed of Montezuma Creek, downstream from the millsite, and 10 continuous core samples in bedrock were collected along the northern boundary of the millsite.

At the millsite, three 5-gallon test-pit samples of tailings were collected at each tailings pile: one sample each of slime, sand, and sand/slime mix. These 12 samples were analyzed for bulk-diffusion coefficient at three moisture contents at 90 percent of standard Proctor density. Sixty split-barrel samples of tailings, collected at random depths, were analyzed for radon-emanation fraction, radium-226 concentration, and moisture content. Four test-pit samples, collected from the surface cover of each tailings pile, were analyzed for gradation and moisture-density relations (Proctor) for soil classification purposes. Twelve Shelby tube samples of tailings were tested for one-dimensional consolidation, dry-bulk density, Atterberg Limits, capillary-moisture relationships, and specific gravity.

Test-pit samples collected at five locations in the peripheral property areas were analyzed for bulk-diffusion coefficient, one-dimensional consolidation, dry-bulk density, Atterberg Limits, and capillary-moisture relationships. Specific gravity, gradation, Proctor, and radon-emanation fraction were analyzed from split-barrel samples collected at each of the five peripheral property locations. Five-gallon samples taken at six locations in the streambed of Montezuma Creek were analyzed for gradation.

Eight split-barrel samples taken from two boreholes in the potential borrow area were analyzed for bulk-diffusion coefficient. One Shelby tube sample from the borrow area was tested for one-dimensional consolidation, dry-bulk density, Atterberg Limits, capillary-moisture relationships, specific gravity, and gradation classification of soils. Drill-hole cuttings from the two borrow area sample locations were tested for moisture-density relations (Proctor).

3.0 RADIOLOGIC ASSESSMENT

3.1 SAMPLING PROCEDURES

The measurement techniques and procedures used for the Monticello Remedial Action Project engineering characterization were based primarily on procedures developed by the DOE Division of Remedial Action Projects (DRAP) Technical Measurements Center (TMC) and on field-implementation experience gained from the radiologic characterization of the Monticello peripheral properties (Marutzky and others, 1985) and the Grand Junction Tailings Pile (Rush and Bonner, 1984).

3.1.1 Drilling and Sampling

Borehole drilling was accomplished using standard geotechnical techniques with a truck-mounted CME-55 auger rig. Hollow-stem augers [7-1/4 inch outside diameter (OD) by 3-1/4 inch inside diameter (ID)] were used to drill to total depth in each hole. Augers were left in place in the hole during radiologic logging operations to prevent hole collapse and to minimize smearing of any downhole contamination. The retrievable center bit used during drilling prevented contamination within the auger itself. The center bit was removed for radiologic logging.

The boreholes were drive sampled using split-barrel samplers (3-inch OD by 24-inch length and 2-inch OD by 24-inch length) and Shelby tube samplers (as presented in Section 4.1.2). The split-barrel sampler was attached to the drill rods and lowered through the hollow stem. A 140-pound drop weight was attached to the drill rods and used to drive the sampler into undisturbed soil. After the sampler was raised to the surface, the split barrel was opened, and approximately 3 inches of the top of the sample was discarded. The sample was cut longitudinally, lithologically logged, and placed in a sample bag labeled with the borehole number, sample number, sample depth, and sample ticket number. The top of the sample bag was folded twice and stapled shut to retain moisture.

The boreholes were drilled and sampled to the estimated depth. Once the borehole was advanced to this depth, a geophysical logging tool was lowered to the bottom of the hole. The hole was deepened if the resulting measurement indicated a Ra-226 concentration in excess of 15 pCi/g above background [the Environmental Protection Agency (EPA) standard for subsurface contamination in any 15-centimeter thick layer]. Additional drilling was performed and measurements were made until the Ra-226 concentration at the bottom of the hole was less than 15 pCi/g above background or refusal. The augers were left in place for geophysical logging.

Once geophysical operations were completed, hole abandonment for all boreholes was accomplished by filling the hole with auger cuttings. Those boreholes encountering subsurface water were plugged with bentonite to the fluid level, and subsequently filled with auger cuttings.

The American Society for Testing Materials (ASTM) standard penetration test was conducted during drive sampling. Modifications involved using a split-barrel sampler with a 3-inch OD to ensure that enough sample volume was obtained for radium analysis. The sampler was driven with blows delivered by dropping a 140-pound weight a vertical distance of 30 inches. The number of blows required to drive the sampler through each 6-inch increment was recorded on the lithologic logs (see Appendix A).

3.1.2 Radiologic and Moisture Analysis

Following transport to the DOE Grand Junction Projects Office, selected soil samples to be analyzed by the Bendix Analytical Laboratory for radium-226 were weighed, dried, reweighed, crushed and ground to -28 mesh, blended, and sealed in sample cans. The difference in weight after drying, loss-on-drying (LOD) in percent, was recorded for the samples. The samples were stored for at least 21 days to allow the radon and radon daughters to reach equilibrium with

any radium present. The samples were analyzed for radium-226, thorium-232, and potassium using high-resolution germanium gamma-ray-spectroscopy systems (Dechant and Donivan, 1984).

3.1.3 Disequilibrium

The amount of disequilibrium between radium and its radon daughters was determined from laboratory analysis of borehole samples. The samples were processed 'as is', without crushing or drying, and sealed in cans. Equivalent-radium concentrations were measured at 2 to 12 hours after canning, and again after 6 days. Estimates of the radon-disequilibrium ratio were made by calculating the radium concentration at disequilibrium and at equilibrium, using the standard equations for ingrowth and decay of the various isotopes involved (Marutzky and others, 1985; Evans, 1980; Scott and Dodd, 1960). Following disequilibrium measurements, the samples were processed for gamma-ray-spectroscopic determination of radium-226, thorium-232, and potassium (see Section 3.1.2). The average disequilibrium between radium and its radon daughters in the analyzed samples is 36 percent, which is consistent with results found in Marutzky and others (1985).

3.1.4 Lithologic Borehole-Logging Procedures

A lithologic log was prepared for each borehole from which the split-barrel or Shelby tube samples were taken. The lithologic logs are presented in Appendix A. Standard penetration tests are also noted on the lithologic logs. The subsurface materials are classified in accord with the Unified Soil Classification System (U.S. Bureau of Reclamation, 1974).

3.1.5 Geophysical Borehole-Logging Procedures

Boreholes accessible by two-wheel-drive truck were logged using a Bendix computer-based geophysical logging (Compulogger) system. The probe, which contains a 2-inch diameter by 6-inch length sodium iodide detector, was raised from the bottom to the top of the borehole at an approximate rate of 1.5 feet per minute. Data were recorded at each 0.5-foot interval. Repeat logs were made of the entire borehole to confirm the measurements obtained during the main logging phase.

The gamma-ray detection system was operated in a linear (energy-proportional) mode. Uphole electronics provided system-gain stabilization by monitoring the 835-keV gamma-ray peak from a manganese-54 source contained in the probe. Pulse-height data were collected from three single-channel-analyzer (SCA) windows corresponding to the principal energy peaks from the decays of potassium, radium, and thorium. Data from a fourth SCA window, the total-count window (1050 to 3000 keV), were collected to provide statistically improved radium concentrations. The collected data were manually entered into the data base of a Zenith Z-100 portable computer and manually verified in accord with approved quality assurance procedures.

To determine radium concentrations from the total-count channel, the count rates were first corrected for attenuation due to formation moisture content (Marutzky and others, 1985), borehole fluid (if present), and auger casing and

auger joint effects (see Appendix B). A correction was also applied for contributions from potassium and thorium concentrations. The data were then spatially deconvolved (George and Price, 1982).

In areas not accessible by two-wheel-drive truck, logging was performed using a portable gross-count system. The system consists of an Eberline Model PRS-1 field survey meter (RASCAL) connected by 20 feet of cable to a waterproof Eberline Model SPA-3, 2-inch-by-2-inch sodium iodide detector. The system operates on a counting plateau in a gross-count mode, which counts all gamma rays with energies exceeding approximately 30 keV.

The detector was manually lowered to the bottom of the borehole in 0.5-foot increments, with 30-second measurements recorded at each stop. The detector was subsequently raised to the top of the borehole in 0.5-foot intervals as the repeat log. The data were manually entered into the data base of a Zenith Z-100 portable computer and manually verified in accord with approved quality assurance procedures. The entered and verified data were corrected (as described for the truck-mounted logging system) for average moisture content, potassium and thorium concentrations, and auger casing and auger joint effects, and the data were spatially deconvolved (see Appendix B).

To determine the radium concentration from the corrected count-rate data measured in the formation, the computer program LOGCALC (Showalter, 1986) was utilized. The LOGCALC program uses the calibration coefficients determined in the models maintained by the DOE Grand Junction Projects Office (George and Knight, 1982).

Both logging systems were calibrated at the DOE Grand Junction Projects Office calibration facilities once every 6 months. Instrument response field checks were made before use each day, and the results were monitored for compliance with quality-control limits established on the statistical basis of previous response checks.

3.2 RESULTS

The borehole numbers, coordinates, elevations, log depths, and fluid levels of the 22 auger holes drilled are presented in Table 3. The boreholes were logged with a Compulogger System 1815, unless noted otherwise. A total of 554.5 feet of soil was drilled, of which 274 feet were sampled. Sixty-six samples were analyzed for radium-226, thorium-232, potassium, disequilibrium, and moisture content (LOD) (see Tables 4 and 5). Cross sections depicting the composition and subsurface contamination of each of the tailings piles are shown in Plate 2. A summary of borehole contamination is presented in Table 6.

3.2.1 Acid Tailings Pile

The sand cover of the Acid Tailings Pile ranges in thickness from 2.0 feet to 2.5 feet in Boreholes 85-10, 85-11, and 85-12 (refer to Cross Section A-A on Plate 2). Clay (slime) tailings, with some interbedded sand layers, are predominant in Boreholes 85-11 and 85-12. The slimes vary in color (red, black, purple, and yellow), which may be the result of the type of ore processed. Borehole 85-10 contains layers of primarily sand tailings, which are underlain by alluvial clay and gravel. Depth to interface of the tailings and

Table 3. Summary of Borehole Data for the Monticello Millsite

Borehole Number	Elevation (ft)	Log Depth (ft)	Fluid Level (ft)
85-01	6897.2	49.0	36.5
85-02	6898.5	42.0	11.5
85-03[a]	6871.5	14.4	-
85-04	6875.9	28.5	-
85-05	6874.6	18.5	-
85-06	6850.9	32.5	27.8
85-07	6848.6	37.0	34.0
85-08	6849.9	48.5	48.5
85-09	6850.3	35.5	-
85-10	6896.8	46.5	-
85-11	6896.1	37.0	-
85-12	6897.4	25.5	-
85-13[b]	6934.7	8.6	-
85-14[c]	6982.4	9.5	-
85-15	6841.5	35.5	-
85-16	6820.0	16.0	10.8
85-17[c]	6782.2	13.0	-
85-18	6803.8	8.9	7.8
85-19[c]	6937.2	4.4	-
85-20[c]	6871.3	4.5	-
85-21[c]	6884.8	12.8	-
85-22	6880.0	Not Logged	-
85-23	6877.9	29.0	10.0
85-24	6868.4	51.5	12.6
85-25[b]	6912.1	5.6	-

[a]Logged with Compulogger 1815 and RASCAL C-3958S.
[b]Logged with RASCAL C-3572S.
[c]Logged with RASCAL C-3958S.

the original surface is shown on the lithologic logs (see Appendix A); the interface is also indicated on the geophysical logs (see Appendix B), and for most boreholes these two types of logs agree. The radiologic logs indicate that the clay (slime) layers contain higher concentrations of radium than the sand layers. The radium concentrations of the slimes range from 700 to 1100 pCi (Ra-226)/g, with a moisture content range of 29.0 to 44.6 percent. The radium concentrations of the sand tailings range from 400 to 600 pCi(Ra-226)/g, with an average moisture content of 13.0 percent (see Table 5). The depth of the subsurface contamination, >16 pCi(eRa-226)/g* above background as determined from the geophysical logs, is presented in Table 6 and Appendix B. Contamination extends below the tailings interface to a total depth of 16.0 feet in Borehole 85-12, 32.0 feet in Borehole 85-10, and 33.0 feet in Borehole 85-11.

*For purposes of this study, radiometric measurements made indirectly by measurement of radiation from sources other than the decay of the nuclide of interest are reported as 'equivalent' concentrations, denoted by an 'e' prefix, i.e., pCi(eRa-226)/g.

3.2.2 East Tailings Pile

Boreholes 85-06, 85-07, 85-08, and 85-09 were drilled in the East Tailings Pile (refer to Cross Section E-E on Plate 2). Thickness of the clay cover varies from 1.5 feet in Borehole 85-07 to 7.0 feet in Borehole 85-08, where materials from the vicinity properties were disposed. Lithologic logs show interbedded sand tailings and clays (slimes) in Boreholes 85-08 and 85-09,

Table 4. Gamma-Ray-Spectroscopy Data for Soil Samples

Borehole Number	Grid Coordinates North	Grid Coordinates East	Depth (ft)	Sample (MKB No.)	Concentration[a] Ra-226 (pCi/g)	Concentration[a] Thorium (ppm)	Concentration[a] Potassium (%)
85-01	11060	21250	8-10	653	517 ± 40	< 124	< 2.5
			10-12	654	1308 ± 101	< 237	< 5.1
			19-21	656	597 ± 46	< 133	< 2.6
			29-31	658	398 ± 31	< 78	< 1.5
			34-36	659	3 ± 1	< 4	2.4 ± 0.9
85-02	10880	21300	4- 6	662	1421 ± 110	< 1	< 5.2
			14-16	664	766 ± 59	< 154	< 3.1
			24-26	666	1796 ± 139	< 454	< 8.9
			34-36	668	425 ± 33	< 94	< 2.0
			44-46	670	408 ± 32	< 97	< 1.9
85-25	11107	20691	0- 2	672	399 ± 31	< 81	< 1.6
			2- 4	673	53 ± 4	< 14	1.8 ± 1.0
85-05	11150	21900	2- 4	676	28 ± 2	< 10	1.3 ± 1.0
			4- 6	677	1007 ± 78	< 251	5.0
			8-10	679	5 ± 1	< 3	2.0 ± 1.1
			10-12	680	5 ± 1	< 6	1.3 ± 1.1
85-04	11090	21740	8-10	683	772 ± 60	< 211	< 3.8
			10-12	684	225 ± 17	< 28	< 1.0
85-13	11327	21026	2- 4	686	14 ± 1	< 4	2.0 ± 1.0
			0- 2	687	5 ± 1	< 3	2.4 ± 0.9
			4- 6	688	15 ± 1	< 8	1.4 ± 0.9
85-06	10840	22250	4- 6	690	415 ± 32	< 101	< 2.0
			6- 8	691	340 ± 25	< 68	< 1.4
			10-12	693	381 ± 27	< 59	< 1.3
			14-16	695	224 ± 16	< 42	< 0.9
85-07	10750	22660	4- 6	698	480 ± 35	< 70	< 1.5
			14-16	700	1443 ± 105	< 320	< 6.1
			24-26	702	643 ± 47	< 127	< 2.6
			29-31	704	5 ± 1	< 2	3.4 ± 0.3
85-09	11001	22850	6- 8	707	74 ± 5	< 13	2.7 ± 0.4
			8-10	708	1243 ± 90	< 105	< 4.5
			10-12	709	25 ± 2	< 6	2.9 ± 0.3
			12-14	710	14 ± 1	< 2	3.0 ± 0.3

[a] A less-than sign (<) indicates that the minimum detection limit based on Compton background was reached.

Table 4 (continued). Gamma-Ray-Spectroscopy Data for Soil Samples

Borehole Number	Grid Coordinates North	Grid Coordinates East	Depth (ft)	Sample (MKB No.)	Concentration[a] Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)
85-08	10750	23140	10-12	713	291 ± 21	< 60	< 1.1
			14-16	715	1759 ± 128	< 276	< 5.9
			16-18	716	1451 ± 105	< 287	< 5.1
			18-20	717	1527 ± 111	< 306	< 6.6
			20-22	718	1646 ± 120	< 304	< 7.8
85-10	10430	21890	9-11	724	434 ± 31	< 69	< 1.5
			14-16	725	1224 ± 89	< 235	< 5.0
			19-21	726	964 ± 70	< 168	< 3.5
			24-26	727	1553 ± 120	< 266	< 5.3
			31-33	729	213 ± 17	< 53	< 1.0
85-12	10090	22001	6- 8	733	1178 ± 91	< 316	< 6.3
			8-10	734	1211 ± 110	< 277	< 5.1
			10-12	735	1470 ± 134	< 325	< 6.0
			12-14	736	962 ± 87	< 422	< 7.8
			16-18	738	61 ± 6	< 9	< 0.2
85-11	10180	21800	6- 8	742	1460 ± 132	< 492	< 9.1
			8-10	743	1573 ± 143	< 362	< 6.7
			10-12	744	1521 ± 139	< 578	< 10.7
			12-14	745	1398 ± 127	< 487	< 9.0
			14-16	746	1483 ± 134	< 570	< 10.5
			16-18	747	1637 ± 149	< 522	< 9.6
85-03	10882	21011	4- 6	750	6 ± 1	< 5	2.2 ± 0.5
85-20	10760	20705	2- 4	754	3 ± 1	< 4	2.8 ± 0.5
85-21	10160	20205	2- 4	757	79 ± 7	< 19	< 0.4
			5- 7	758	9 ± 1	< 6	2.1 ± 0.5
85-19	9360	21405	2- 4	760	2 ± 1	< 4	< 0.1
85-14	11270	20400	0- 2	761	3 ± 1	< 5	< 0.1
			2- 4	762	2 ± 1	< 12	< 0.2
			4- 6	763	4 ± 1	< 16	0.8 ± 0.4
			6- 8	764	2 ± 1	< 0	< 0
			8-10	765	3 ± 1	< 0	2.2 ± 0.5
85-17	10035	25005	2- 4	767	2 ± 1	< 0	2.5 ± 0.5
86-18	10365	23605	2- 4	769	78 ± 7	< 25	< 0.5

[a]A less-than sign (<) indicates that the minimum detection limit based on Compton background was reached.

Table 5. Results of Measurements of Disequilibrium Between Radium and Its Gamma-Emitting Radon Daughters and Moisture Content

Borehole Number	Grid Coordinates North	Grid Coordinates East	Depth (ft)	Sample (MKB No.)	Ra-226 (pCi/g)	Disequilibrium (%)	Moisture LOD (%)
85-01	11060.0	21250.0	8-10	653	517	50.1	7.0
			10-12	654	1308	53.3	20.8
			19-21	656	597	46.9	16.0
			29-31	658	398	36.2	11.1
85-02	10880.0	21300.0	4- 6	662	1421	34.1	29.2
			14-16	664	766	46.5	9.5
			24-26	666	1796	22.9	30.4
			34-36	668	425	27.5	8.4
			44-46	670	408	26.3	19.7
85-25	1106.5	20691.0	0- 2	672	399	8.6	7.8
			2- 4	673	53	13.9	8.2
85-05	11150.0	21900.0	2- 4	676	28	44.9	16.2
			4- 6	677	1007	60.4	20.8
			8-10	679	5	51.6	22.0
			10-12	680	5	68.9	18.6
85-04	11090.0	21740.0	8-10	683	772	33.4	24.4
			10-12	684	225	51.5	23.3
85-13	11326.5	21025.5	2- 4	686	14	42.1	11.2
			0- 2	687	5	44.9	5.4
			4- 6	688	15	38.5	10.4
85-06	10840.0	22250.0	4- 6	690	415	19.4	12.6
			6- 8	691	340	21.3	11.3
			10-12	693	381	25.1	11.0
			14-16	695	224	24.5	20.6
85-07	10750.0	22660.0	4- 6	698	480	45.7	16.2
			14-16	700	1443	14.2	39.1
			24-26	702	652	41.0	27.5
85-09	11001.0	22850.0	6- 8	707	74	31.5	21.0
			8-10	708	1243	19.7	21.5
			12-14	710	14	39.5	21.9
85-08	10750.0	23140.0	10-12	713	291	11.9	17.5
			14-16	715	1759	24.7	37.7
			16-18	716	1451	22.6	37.6
			18-20	717	1527	11.7	37.2
			20-22	718	1646	18.7	37.4
85-10	10430.0	21890.0	9-11	724	434	20.2	13.0
			14-16	725	1224	36.5	33.3
			19-21	726	964	28.4	29.0
			24-26	727	1553	30.1	34.5
			31-33	729	214	64.2	18.3
85-12	10090.0	22001.0	6- 8	733	1178	32.2	32.7
			8-10	734	1211	21.9	33.7
			10-12	735	1470	17.5	41.0
			12-14	736	962	49.2	35.4
			16-18	738	61	37.7	19.3

Table 5 (continued). Results of Measurements of Disequilibrium Between Radium and Its Gamma-Emitting Radon Daughters and Moisture Content

Borehole Number	Grid Coordinates North	Grid Coordinates East	Depth (ft)	Sample (MKB No.)	Ra-226 (pCi/g)	Disequilibrium (%)	Moisture LOD (%)
85-11	10180.0	21800.0	6- 8	742	1460	22.2	35.0
			8-10	743	1573	26.1	38.1
			10-12	744	1521	21.6	39.2
			12-14	745	1398	20.6	37.3
			14-16	746	1483	12.8	42.0
			16-18	747	1637	19.2	44.6
85-03	10882.0	21011.0	4- 6	750	6	29.6	19.2
85-20	10760.0	20750.0	2- 4	754	3	41.2	17.8
85-21	10160.0	20205.0	2- 4	757	79	43.2	8.0
			5- 7	758	9	32.6	7.1
85-19	9360.0	21405.0	2- 4	760	2	38.9	9.6
85-14	11270.0	20400.0	0- 2	761	3	41.1	8.8
			2- 4	762	2	43.7	17.7
			4- 6	763	4	44.8	11.0
			6- 8	764	2	7.1	17.9
			8-10	765	3	40.9	17.8
85-17	10365.0	23605.0	2- 4	767	2	36.0	10.8
85-18	10035.0	25005.0	2- 4	769	78	46.6	11.9

predominantly sand in Borehole 85-06, and clay (slime) tailings in Borehole 85-07. Based on the lithologic logs, interface between the tailings and original surface is a unique layer, or marker bed, containing abundant organic-clay material. This organic layer is present in all four boreholes drilled in the East Tailings Pile and is underlain by clay, which is, in turn, underlain by gravel. The radium concentrations of the slimes range from 500 to 1100 pCi(Ra-226)/g, with moisture content ranging from 21.1 to 39.1 percent, depending on the quantity of sand. The radium concentrations of the sand tailings range from 200 to 600 pCi(Ra-226)/g, with moisture content ranging from 11.0 to 17.5 percent (see Table 5). Moisture content of the clay substrate material ranges from 15.9 percent in Borehole 85-07 to 21.9 percent in Borehole 85-09. Geophysical logging results of all the boreholes indicate contamination of the organic layer and of the alluvium clay below the organic layer (refer to Table 6). The deepest contamination occurs in Borehole 85-08 at a depth of 33.5 feet (see Table 6), or 5.0 feet below the tailings subsurface.

3.2.3 Vanadium Tailings Pile

Boreholes 85-04 and 85-05 were drilled in the Vanadium Tailings Pile (see Cross Section V-V on Plate 2). The clay cover ranges in thickness from 1.5 feet in Borehole 85-04 to 5.7 feet in Borehole 85-05. Lithologic logs indicate shallow depths of tailings; the tailings consist predominantly of clay (slime), with some sand found in Borehole 85-04. Lithologic logs indicate an organic layer at the interface of the tailings and substrate material, similar

Table 6. Borehole Contamination Summary

Borehole Number	Location	Tailings/Subsurface Interface (ft)	Depth (ft) of Contamination [>16pCi(Ra-226)/g]	Contaminated Subsurface (difference in ft)
85-01	Carbonate Tailings Pile	34.0	>34.0[a]	----
85-02	Carbonate Tailings Pile	51.0	52.0	1.0
85-03	Carbonate Tailings Pile	4.0	4.5	0.5
85-04	Vanadium Tailings Pile	10.5	13.0	2.5
85-05	Vanadium Tailings Pile	7.5	8.5	1.0
85-06	East Tailings Pile	16.0	17.0	1.0
85-07	East Tailings Pile	26.0	29.0	3.0
85-08	East Tailings Pile	28.5	33.5	5.0
85-09	East Tailings Pile	10.0	12.5	2.5
85-10	Acid Tailings Pile	31.5	32.0	0.5
85-11	Acid Tailings Pile	22.5	33.0	10.5
85-12	Acid Tailings Pile	14.5	16.0	1.5
85-13	Mill Area	NT[b]	6.0	----
85-14	Mill Area	NC[c]	----	----
85-15	Borrow Area	NC[c]	----	----
85-16	Borrow Area	NC[c]	----	----
85-17	Peripheral Property	NC[c]	----	----
85-18	Peripheral Property	NT[b]	4.0	----
85-19	Peripheral Property	NC[c]	----	----
85-20	Peripheral Property	NC[c]	----	----
85-21	Peripheral Property	5.0	7.0	2.0
85-22	North Millsite Boundary	NC[c]	----	----
85-23	North Millsite Boundary	NC[c]	----	----
85-24	North Millsite Boundary	NC[c]	----	----
85-25	Mill Area	1.0	3.5	2.5
			AVERAGE	2.5

[a] Depth of contamination undetermined.
[b] NT = No Tailings.
[c] NC = No Contamination.

to that found under the East Tailings Pile. This organic layer is, in turn, underlain by an alluvial clay layer, with moisture content ranging from 18.6 to 22.0 percent. The radium concentrations of the slimes range from 400 to 980 pCi(Ra-226)/g, with moisture content ranging from 20.8 to 24.4 percent. The radium concentrations of the sand tailings range from 200 to 300 pCi(Ra-226)/g (see Table 5). The geophysical logging results indicate contamination extends 1.0 foot below the interface of tailings and natural substrate in Borehole 85-05, and 2.5 feet below this interface in Borehole 85-04 (see Table 6). Geophysical logs also indicate that the drilling augers may have been contaminated in Borehole 85-04.

3.2.4 Carbonate Tailings Pile

Boreholes 85-01 and 85-02 are located in the Carbonate Tailings Pile (see Cross Section C-C on Plate 2). Lithologic logs indicate a clay cover 2.0 feet thick, evenly distributed over the pile. Borehole 85-03, located on the west slope of the tailings pile near the bottom of an erosional gully, has a sand covering 3.0 feet thick and is underlain by 1.5 feet of sand tailings, which correlates with geophysical logging (see Appendices A and B). Boreholes 85-01 and 85-02 were drilled in sand tailings, some clay (slime) layers, and thin interbedded layers of sand/slime mixed. The clay (slime) and sand tailings layers vary in color (red, brown, and purple). In Borehole 85-02, a distinct organic clay layer interfaces with the tailings and clay substrate below, while in Borehole 85-01 a trace of organics (roots) was found at the interface. Both boreholes were drilled until refusal. Radium concentrations of the sand tailings range from 400 to 600 pCi(Ra-226)/g, with moisture content ranging from 7.0 to 11.1 percent. The radium concentrations of the slimes range from 700 to 1800 pCi(Ra-226)/g, with moisture content ranging from 16.0 to 30.4 percent (see Table 5). Geophysical logging was not completed to the total depth drilled because material flowed into the hollow-stem auger after the center stem and bit were removed. Contamination in Borehole 85-02 was found to the total depth drilled (52 feet). The depth of contamination in Borehole 85-01 is questionable due to possible auger-stem contamination from the tailings flowing down the outside of the auger (see Appendix B).

3.2.5 Mill Area

Lithologic logs of Boreholes 85-13, 85-14, and 85-25 indicate primarily clay (slime) with some sand (see Appendix A). Geophysical logging results indicate Borehole 85-14 is uncontaminated, but that Boreholes 85-25 and 85-13 are contaminated to 3.5 feet and 6.0 feet, respectively.

3.2.6 Peripheral Properties

Five boreholes are located on properties adjacent to the millsite area. Lithologic logs indicate sand, clay, and gravel in the boreholes (see Appendix A). Borehole 85-18 is located in a pond area and contains a distinct layer of organic clay, which may represent the original pond surface. Contamination was found in Borehole 85-21 to a depth of 7.0 feet and in Borehole 85-18 to a depth of 4.0 feet (see Appendix B).

3.2.7 Borrow Area

Boreholes 85-15 and 85-16 were drilled in the borrow area east of the millsite. Lithologic logs indicate sand and clay layers (see Appendix A). Geophysical borehole logs indicate no contamination [<5 pCi(eRa-226)/g] in both boreholes (see Appendix B).

3.3 SUMMARY

Based upon results of the lithologic and radiologic data, each tailings-material type bears a distinct relationship to the substrate material, formation moisture, and Ra-226 lab analysis.

The tailings consist of interbedded sand and clay (slime) layers. Most of the boreholes drilled in the tailings piles are underlain by clay (alluvium) and gravel. A distinct organic clay layer, probably the original ground surface, underlies the tailings beneath all the tailings piles north of Montezuma Creek. This organic clay layer is, in turn, underlain by clay (alluvium) or bedrock (Dakota Sandstone). The organic layer was not present under the Acid Tailings Pile south of Montezuma Creek.

Geophysical logs of boreholes drilled in the four tailings piles indicate contamination above 16 pCi(Ra-226)/g extends below the tailings/substrate interface an average of 2.5 feet, with a maximum of 10.5 feet (Borehole 85-11). Results of geophysical logging and Ra-226 laboratory analysis of samples agree, except in boreholes containing slimes with high Ra-226 values. Laboratory analysis shows that the Ra-226 concentration of some slimes exceeds approximately 1700 pCi(Ra-226)/g. Some analytical results are not consistent with the geophysical logging results, due to deadtime problems in the tool at high-radium concentration values.

In the peripheral properties and mill area, contamination is shallow and present in four of the five boreholes drilled. The material in the borrow area is mostly clay with sands, and geophysical logs indicate it is uncontaminated.

4.0 GEOTECHNICAL ASSESSMENT

4.1 SAMPLING PROCEDURES

4.1.2 Shelby Thin-Wall Tube Sampling

Boreholes were drilled on the millsite and peripheral properties as described in Section 3.1. In addition to drive sampling, each borehole drilled in the tailings piles and Borehole 85-16 in the borrow area was sampled using a 3-inch OD by 30-inch length Shelby thin-wall tube sampler. Once the auger advanced the hole to the desired sample depth, the center bit was removed. The Shelby thin-walled tube sampler was attached to drill rods and lowered through the hollow stem to sample the soil at the bottom of the hole. A drive head was attached to the top of the drill rods holding the sampler, the sampler was hydraulically pushed into the undisturbed soil, and the drill rod

was rotated one-quarter turn to shear off the sample. After the sample was removed from the hole, 1 inch of material was removed from the bottom and top of the sample and melted paraffin was poured into each end to prevent moisture loss. Plastic caps were placed on each end of the tube and taped in place. Each sample was labeled with the pertinent data and stored upright in special containers to prevent compaction.

4.1.3. Test-Pit and Bulk Samples

One test pit was dug using a backhoe in each of the four tailings piles. Lithologic logs of the drilled boreholes were used to locate the test pits to minimize sample depths. A trench was excavated, exposing a vertical surface which was lithologically logged (see Appendix A). Four individual soil-stratum bulk samples were collected from each tailings area: one surface-cover sample, one sand sample, one slime sample, and one sand/slime mix sample. Each test pit was reclaimed with the tailings material and original cover material.

Sediment samples collected from the Montezuma Creek area were obtained by manually digging a shallow test pit at six locations. The bulk samples were placed inside a 5-gallon bucket and the bucket was capped with a rubber-sealed lid to prevent moisture loss. Containers were marked with pertinent test-pit information.

Two 5-gallon test-pit samples were obtained at each borehole location in the peripheral properties. Cover-material borrow area samples were obtained by collecting auger cuttings as the boreholes were drilled. Each sample was placed in a plastic bag inside a 5-gallon bucket, and sealed as previously described.

4.2 RESULTS

Thirteen Shelby tube samples were collected: 12 tailings pile samples and 1 sample from borrow area material. Five split-barrel samples were collected from the peripheral property surface materials.

The Shelby tube samples were analyzed for one-dimensional consolidation, Atterberg limits, capillary-moisture relationships, specific gravity, dry-bulk density, and moisture content. The peripheral property split-barrel samples were analyzed for one-dimensional consolidation, Atterberg limits, capillary-moisture relationships, specific gravity, dry-bulk density, moisture content, constant- or falling-head permeability, and classification of soils.

The four test-pit samples of the tailings piles and the five samples of the peripheral property surface materials were analyzed for moisture-density relations and classification of soils. The two test-pit samples collected from the borrow area were analyzed for moisture-density relations only. The six samples collected from the streambed of Montezuma Creek, downstream from the millsite, were analyzed for particle size.

A summary of the laboratory results from the analyses listed in Table 7 are shown in Table 8, and described in more detail in Appendix C. Radon diffusion tests were performed on test-pit samples of the tailings, peripheral property

Table 7. Type of Geotechnical Analysis Performed on Monticello Soil Samples

Sampling Method and Location/ Geotechnical Analysis for All Samples	Sample	Borehole Number	Depth (ft)
Shelby Tube Samples of Tailings Piles			
One-Dimensional Consolidation (ASTM D2435)	MKB-652	85-01	6- 8
	MKB-661	85-02	2- 4
Atterberg Limits (ASTM D4318-83)	MKB-678	85-05	6- 8
Capillary-Moisture Relationships (ASTM D2325-68)	MKB-682	85-04	4- 6
	MKB-689	85-06	2- 4
Specific Gravity of Soils (ASTM D854-83)	MKB-697	85-07	2- 4
	MKB-706	85-09	4- 6
Dry-Bulk Density	MKB-714	85-08	12-14
Moisture Content	MKB-723	85-10	4- 6
	MKB-732	85-12	4- 6
	MKB-741	85-11	4- 6
	MKB-749	85-03	2- 4
Split-Barrel Samples of Peripheral Property			
One-Dimensional Consolidation (ASTM D2435)	MKB-753	85-20	0- 2
	MKB-756	85-21	0- 2
Atterberg Limits (ASTM D4318-83)	MKB-759	85-19	0- 2
Capillary-Moisture Relationships (ASTM D2325-68)	MKB-766	85-17	0- 2
	MKB-768	85-18	0- 2
Specific Gravity (ASTM D854-83)			
Dry-Bulk Density			
Moisture Content			
Classification of Soils (ASTM D2487)			
Constant- or Falling-Head Permeability (ASTM D2434-68)			
Shelby Tube Samples of Borrow Area			
One-Dimensional Consolidation (ASTM D2435)	MKB-776	85-16	9-10
Atterberg Limits (ASTM D4318-83)			
Capillary-Moisture Relationships (ASTM D2325-68)			
Specific Gravity (ASTM D854-83)			
Dry-Bulk Density			
Moisture Content			
Test-Pit Samples of Tailings Piles			
Moisture-Density Relations (ASTM D698-78)	MKB-779	85-06	~1
	MKB-783	85-04	~1
Classification of Soils (ASTM D2487-83)	MKB-787	85-02	~1
	MKB-791	85-10	~1

Table 7 (continued). Type of Geotechnical Analysis Performed on Monticello Soil Samples

Sampling Method and Location/ Geotechnical Analysis for All Samples	Sample	Borehole Number	Depth (ft)
Test-Pit Samples of Peripheral Property			
Moisture-Density Relations (ASTM D698-78)	MKB-830	85-17	0- 5
	MKB-833	85-18	0- 5
Classification of Soils (ASTM D2487-83)	MKB-828	85-19	0- 5
	MKB-836	85-20	0- 3
Test-Pit Samples of Downstream Creekbed			
Particle Size (ASTM D422)	MKB-841	ZERO	0- 2
	MKB-842	+1000	0- 2
	MKB-843	+2000	0- 2
	MKB-840	+3500	0- 1.5
	MKB-839	+5000	0- 2
	MKB-838	+6500	0- 1.5
Bulk Samples of Borrow Area			
Moisture-Density Relations (ASTM D698-78)	MKB-834	85-15	2-37
	MKB-835	85-16	5.5-12

soils, and cover materials. The results of the tests are listed in Appendix E. One borehole in each of the tailings piles was temporarily cased with aluminum after drilling, and a neutron moisture probe was used to obtain relative moisture data for depths up to 19 feet. The results from these in-situ tests are presented in Appendix D. Previous to the 1985 fieldwork, some preliminary drilling was done on the potential-cover borrow area. Chemical and engineering analyses results from this study are presented in Tables 9 and 10.

4.3 SUMMARY

The tailings materials range in composition from silty sands to silty clay, with specific gravity ranging from 2.57 to 2.76. Moisture-density relationships (Proctor) were measured for the existing cover material and tailings samples down to a maximum of 14 feet. Maximum density/optimum moisture was 114.7 pounds per cubic foot (lb/ft^3)/14.5 percent for the Carbonate Tailings Pile cover, 114.3 lb/ft^3/13.7 percent for the Vanadium Tailings Pile cover, 111.2 lb/ft^3/14.1 percent for the East Tailings Pile cover, and 111.8 lb/ft^3/16.9 percent for the Acid Tailings Pile cover. For each tailings area, the Proctor test results were reported for a sample of sand tailings and slimes. Natural dry density averaged 96.4 lb/ft^3 for the carbonate tailings, 78.4 lb/ft^3 for the vanadium tailings, 101.1 lb/ft^3 for the east tailings, and 72.43 lb/ft^3 for the acid tailings.

Samples of the peripheral property surface soils range in composition from silty sands to organic silts, with specific gravities averaging 2.60. A wide

Table 8. Geotechnical Test Results of Monticello Millsite Soil Samples

GOODSON & ASSOCIATES, INC.
11949 West Colfax Avenue
Lakewood, Colorado 80215

December 20, 1985

G&AI PROJECT NO: 6411.01

MKB No.	Location	Depth (Feet)	Nat. Moist. (%)	Nat. Dry Density (PCF)	Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	ASTM D-698 Density/ Moisture	Specific Gravity	Soil Description/ USCS
652	85-01	6-8'	4.6	89.6			3		NP		2.57	silty clay (CL-ML)
661	85-02	2-4'	4.0	107.5			49		NP		2.60	very silty sand (SM)
787	85-02	1'					66			114.7/14.5		sandy silt (ML)
749	85-03	2-4'	27.4	92.1			84	20	4		2.67	slightly clayey silt (ML)
682	85-04	4-6'	39.8	80.7			44	27	10		2.62	sandy clay (CL)
783	85-04	1'					71			114.3/13.7		sandy silt (SM)
678	85-05	6-8'	41.7	76.1			94	21	5		2.63	clayey silt (CL-ML)
689	85-06	2-4'	5.2	96.4			42		NP		2.67	very silty sand (SM)
779	85-06	1'					52			111.2/14.1		sandy silt (ML)
697	85-07	2-4'	9.9	94.0			19		NP		2.61	silty sand (SM)
714	85-08	12-14'	34.4	108.6			81	41	22		2.70	sandy clay (CL)
706	85-09	4-6'	21.4	100.7			88	42	13		2.63	sandy clay (CL)
723	85-10	4-6'	43.5	66.1			78	29	11		2.63	sandy clay (CL)
791	85-10	1'					49			111.8/16.9		silty sand (SM)
741	85-11	4-6'	39.8	74.8			72	44	20		2.69	sandy clay (CL)
732	85-12	4-6'	40.5	76.4			87	47	10		2.68	slightly sandy silt (ML)

Table 8 (continued). Geotechnical Test Results of Monticello Millsite Soil Samples

GOODSON & ASSOCIATES, INC.
11949 West Colfax Avenue
Lakewood, Colorado 80215

December 20, 1985

C&AI PROJECT NO: 6411.01

HKB No.	Location	Depth (Feet)	Nat. Moist. (%)	Nat. Dry Density (PCF)	Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	ASTM D-698 Density/ Moisture	Specific Gravity	Soil Description/ USCS
834	85-15	2-37'	6.9				82			102.5/19.7		slightly sandy, clayey silt (ML)
835	85-16	5.5-12'	13.2				82			113.7/14.9	2.65	gravelly silt (ML)
776	85-16	9-10'	11.8	121.0			79	36	14		2.61	sandy clay (CL)
766	85-17	0-2'	48.2				31	33	10		2.63	clayey sand (SC)
830	85-17	0-5'			13	6	81			108.3/17.0		gravelly silt (ML)
768	85-18	0-2'	14.3				65	32	14		2.55	sandy clay (CL)
833	85-18	0-5'					80			103.3/19.0		sandy silt (ML)
759	85-19	0-2'	5.8				70	26	6		2.61	sandy clayey silt (CL-ML)
828	85-19	0-5'					73			109.8/15.8		sandy silt, organics (ML-OL)
753	85-20	0-2'	10.8				80	41	7		2.62	sandy silt, organics (OL)
836	85-20	0-3'					71			101.9/18.9		gravelly silt, (topsoil, OL)
756	85-21	0-2'	7.5					30	10		2.60	silty sand, (topsoil, OL)
826	85-21	0-3'					43			115.2/13.6		silty sand (SM)
841	+0	0-2'			19	52	29				2.54	gravelly, silty sand, organics (SM)

Table 8 (continued). Geotechnical Test Results of Monticello Millsite Soil Samples

GOODSON & ASSOCIATES, INC.
11949 West Colfax Avenue
Lakewood, Colorado 80215

December 20, 1985

G&AI PROJECT NO: 6411.01

MKB No.	Location	Depth (Feet)	Nat. Moist. (%)	Nat. Dry Density (PCF)	Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	ASTM D-698 Density/ Moisture	Specific Gravity	Soil Description USCS
842	+1000	0-2'			56	40	4				2.65	sandy gravel (GP) organics
843	+2000	0-2'			0	39	61				2.61	very silty sand (SM) organics
840	+3500	0-1.5'			2	39	59				2.66	sandy silt (ML) organics
839	+5000	0-2'			10	40	50				2.58	gravelly sandy silt (ML) organics
838	+6500	0-1.5'			15	38	47				2.65	gravelly, sandy silt (ML) organics

Table 9. Chemical Analysis of Potential Borrow Material

Drill Hole	Depth (ft)	Sample (MMK No.)	LOD (%)	Ra-226 (pCi/g)	Th (ppm)	K (%)	Grain Density (g/cm³)
GP	0-20	117	9.71	0.8	13.9	1.4	2.71
	20-40	120	4.58	1.0	8.8	0.9	2.69
	40-50	123	5.51	0.4	3.7	0.4	2.66
	at 50 ft hit bottom clays						
GPN	0-20	121	11.79	1.1	14.5	1.4	2.70
	20-40	125	9.73	0.8	7.6	0.8	2.69
	40-60	122	28.87	1.9	17.4	1.3	2.69
	60-80	115	21.64	2.7	21.7	1.3	2.78
	at 80 ft still in clays						
GPSE	0-20	124	5.60	1.1	10.1	1.3	2.70
	20-40	116	7.57	1.9	19.4	1.0	2.73
	40-50	119	3.71	1.4	4.1	2.1	2.66
	at 47 ft hit sandstone						

range of density-moisture relationships was analyzed. Natural moisture of the 2-foot depth of surface soil ranged from 5.8 to 48.2 percent.

The proposed borrow area soil ranges from clayey silt to sandy clay, with specific gravity averaging 2.63. The material contains approximately 80 percent fines, and natural dry density for the material is 121.0 lb/ft³. Due to testing of two large samples of drill cuttings representing depths from 2 to 37 feet and 6 to 12 feet, a wide range of density/moisture values was measured.

5.0 GEOLOGY

5.1 SAMPLING PROCEDURES

A total of eight holes were augered/drilled in order to conduct permeability tests (presented in Section 6), to obtain soil/bedrock profiles along proposed cutoff-wall locations, and to ascertain geotechnical characteristics of the materials drilled.

Unconsolidated material was penetrated with a 6 7/8-inch diameter hollow-stem auger using a truck-mounted Central Mine Equipment (CME) 45B drill rig. Soil samples from most holes were collected every 5 feet, using a 2-inch diameter split-barrel sampler driven 18 inches with a 140-pound hammer falling 30 inches. The number of blows for each 6 inches of penetration was observed and recorded. Soil samples were logged and classified by inspection, in accord with the Unified Soil Classification System. Relative densities of the materials encountered were estimated using the standard penetration test conversions given in Lambe and Whitman (1969), p. 77.

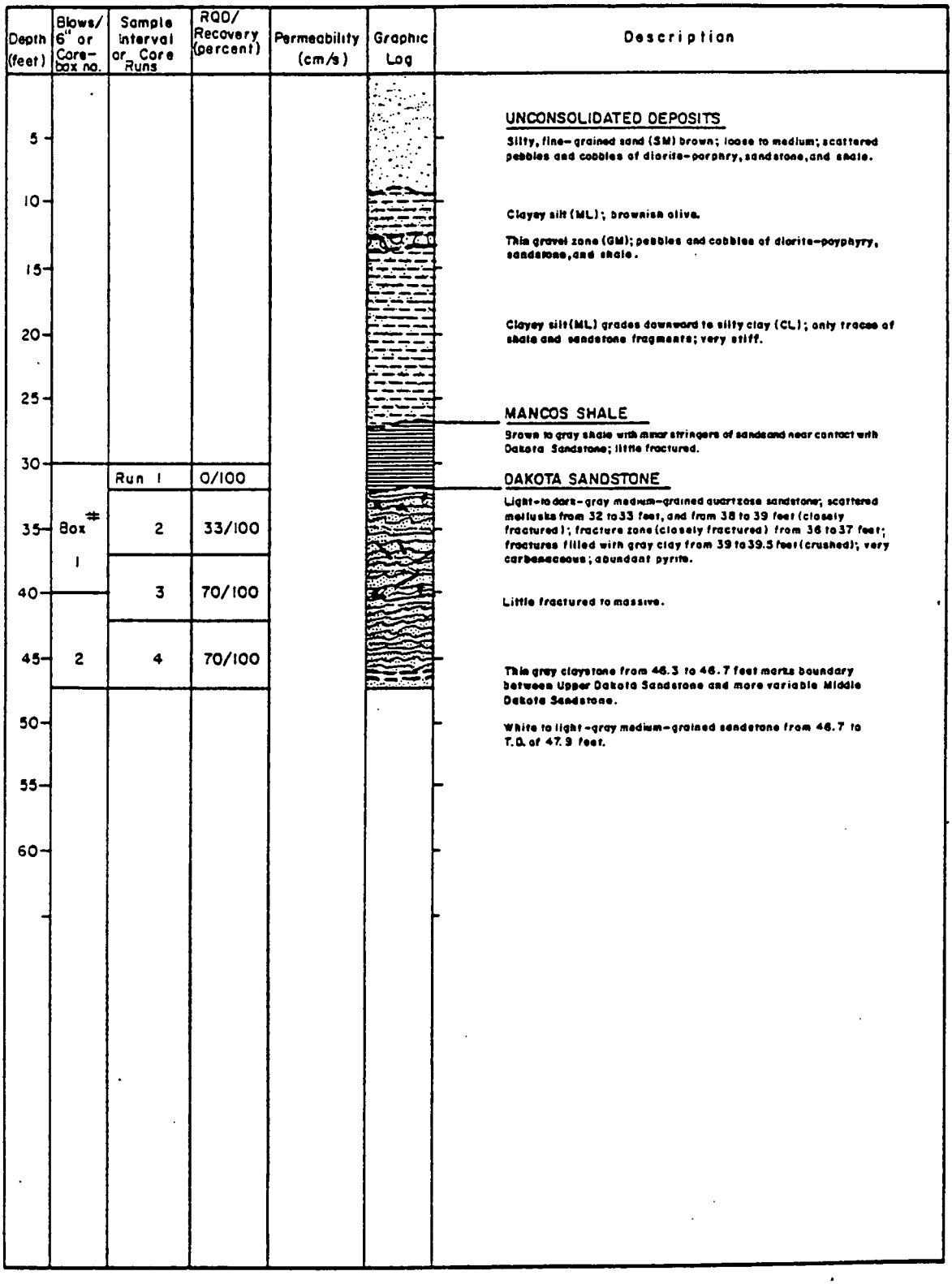


Figure 3. Geotechnical Log of Borehole 85-22

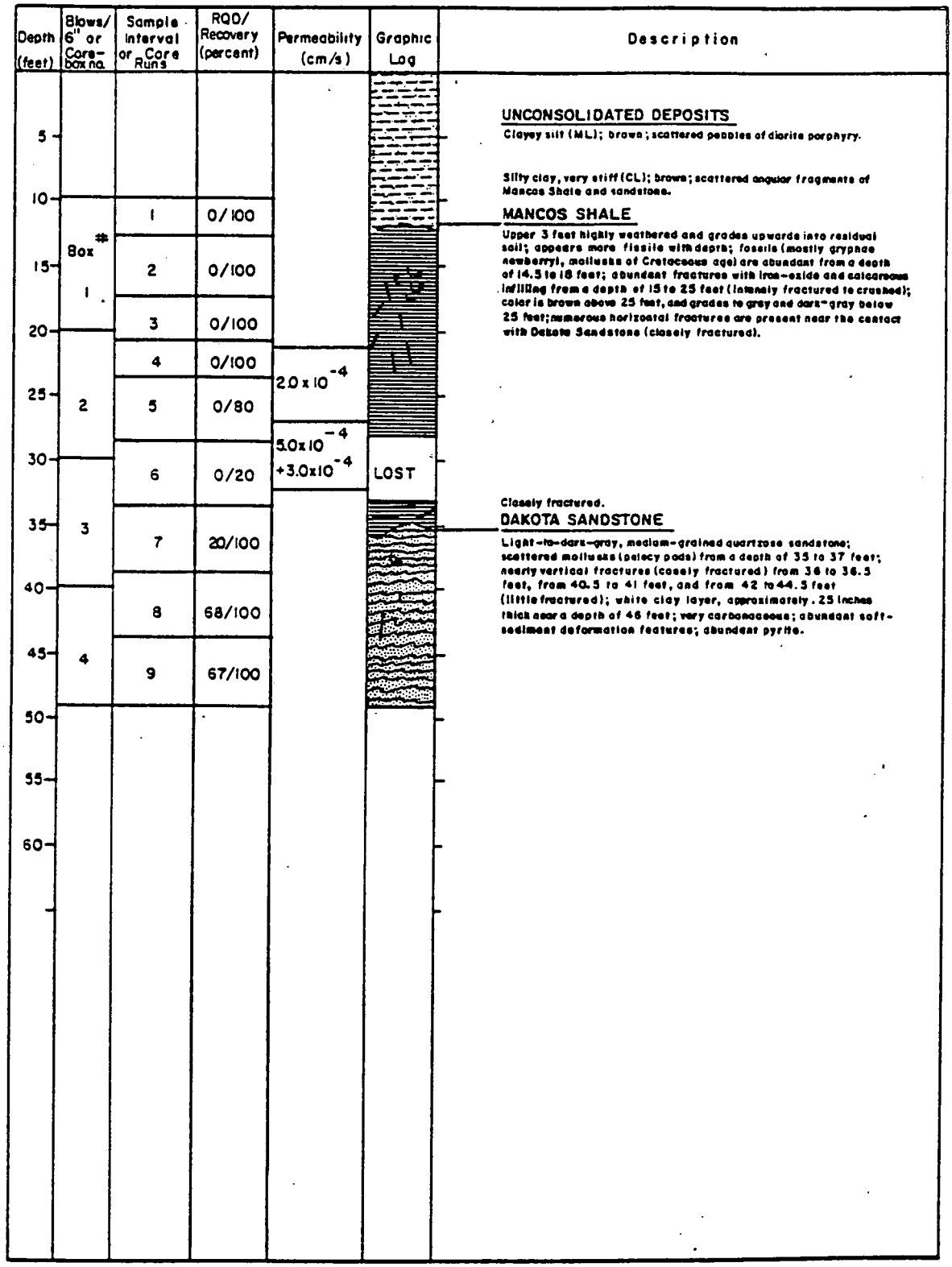


Figure 4. Geotechnical Log of Borehole 85-23

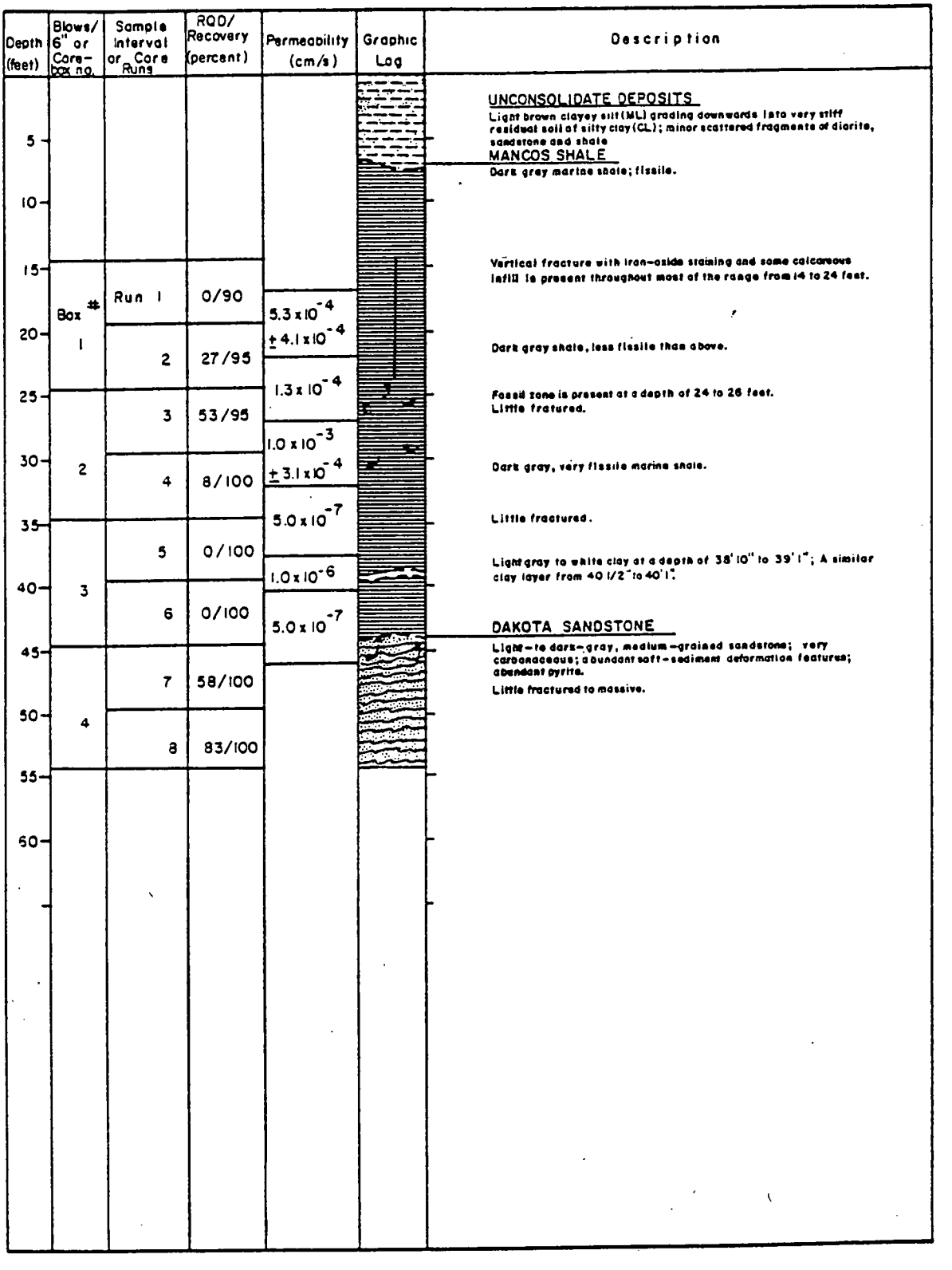


Figure 5. Geotechnical Log of Borehole 85-24

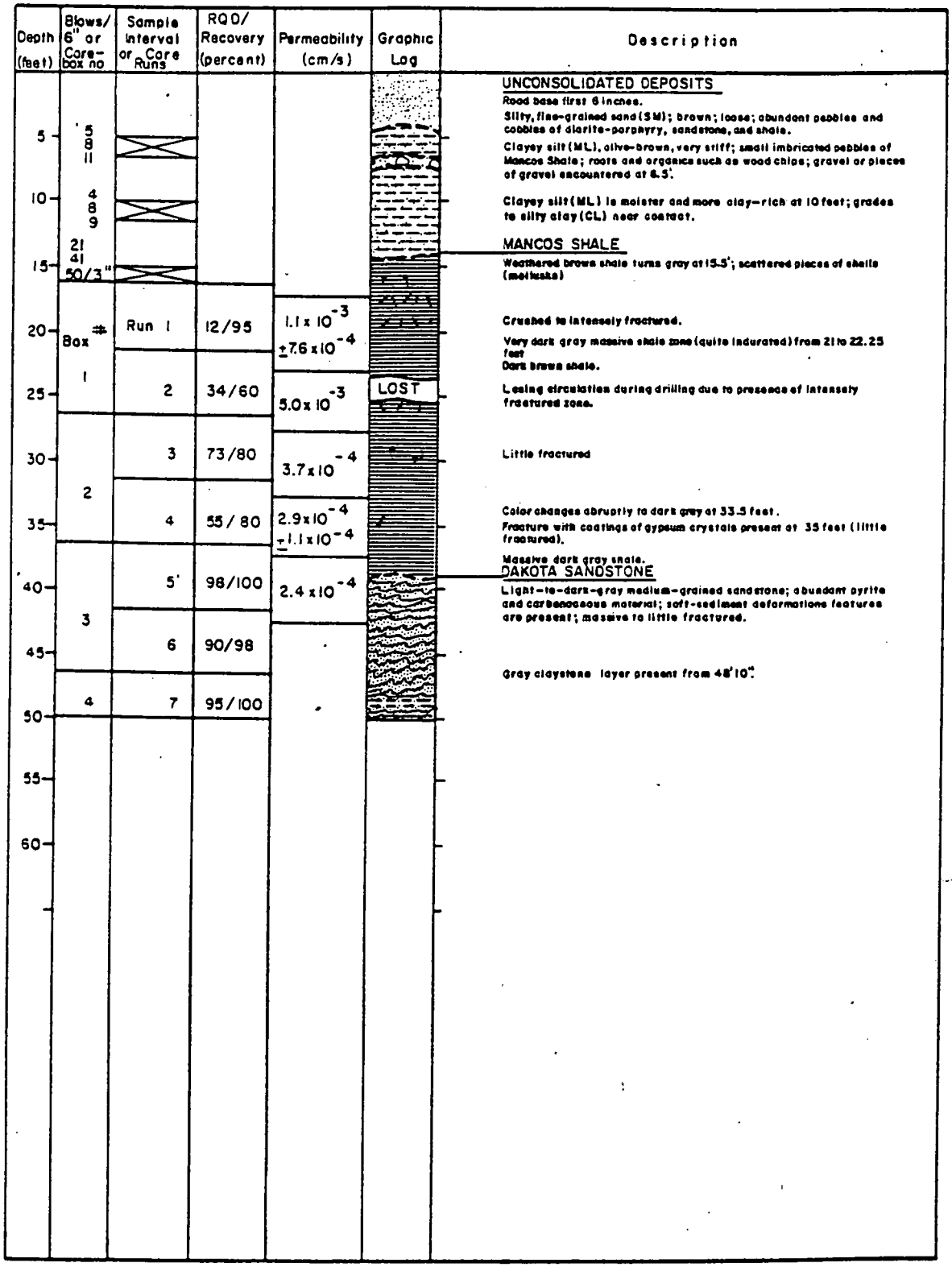


Figure 6. Geotechnical Log of Borehole 85-26

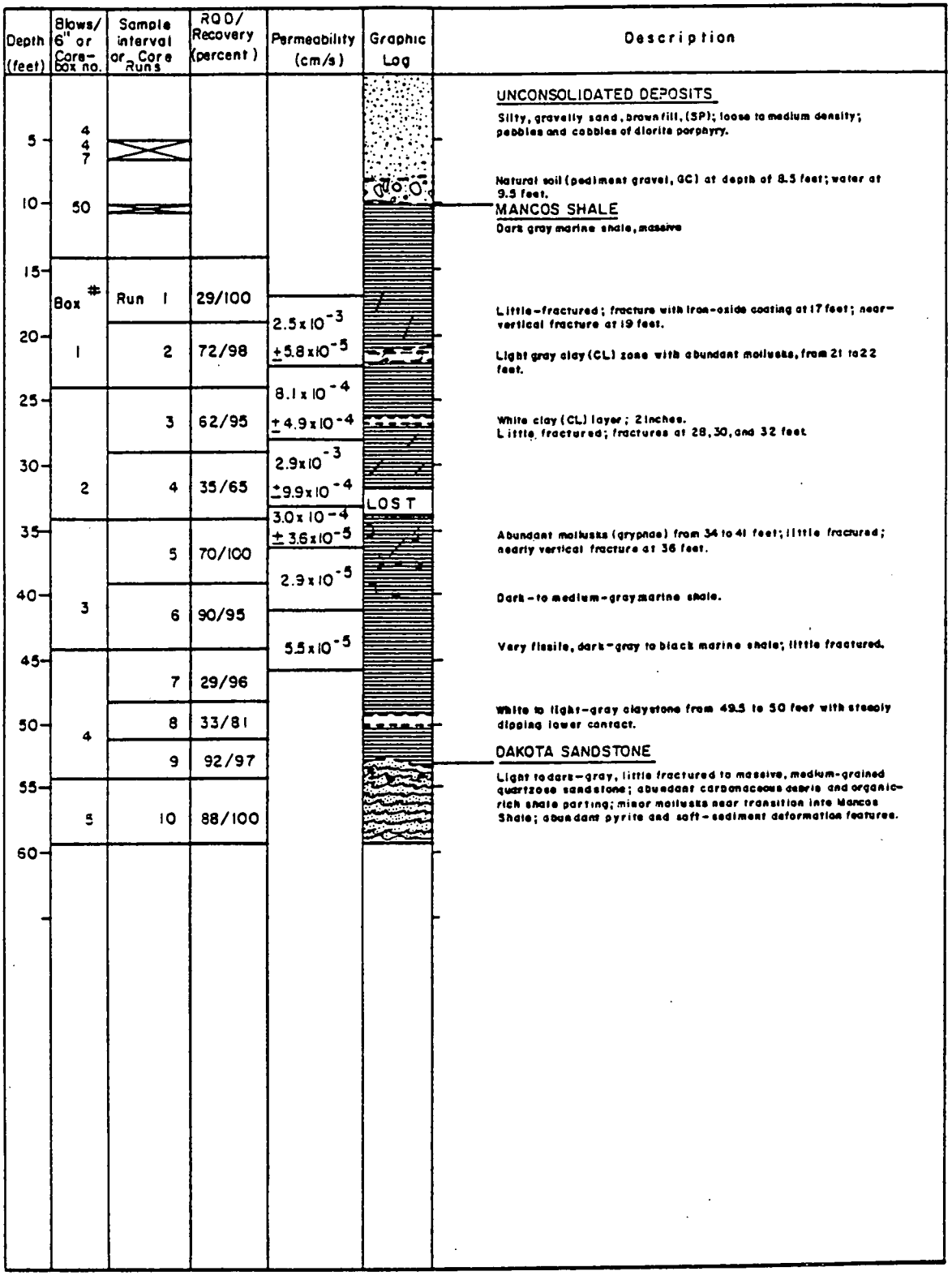


Figure 7. Geotechnical Log of Borehole 85-27

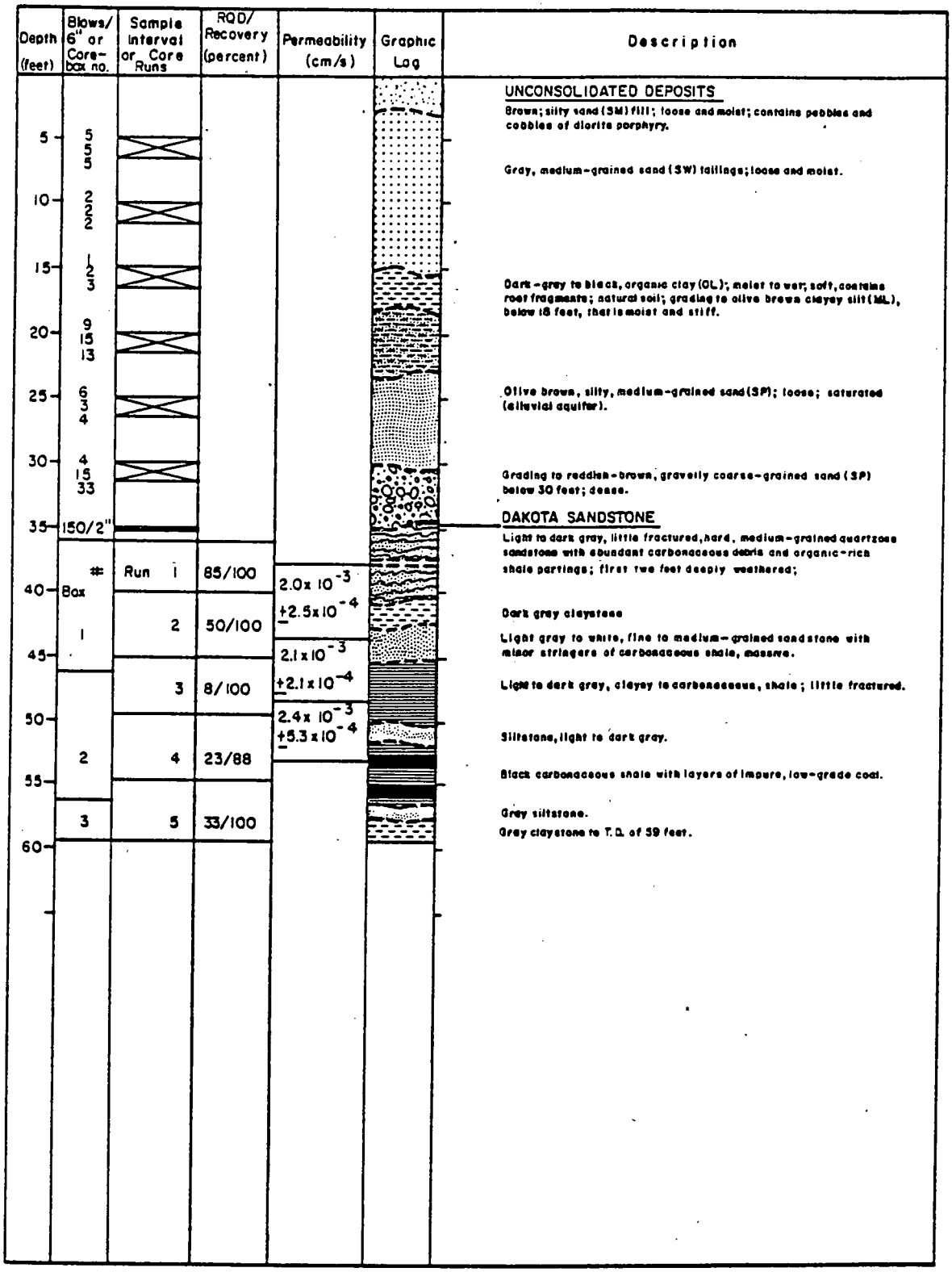


Figure 8. Geotechnical Log of Borehole 85-28

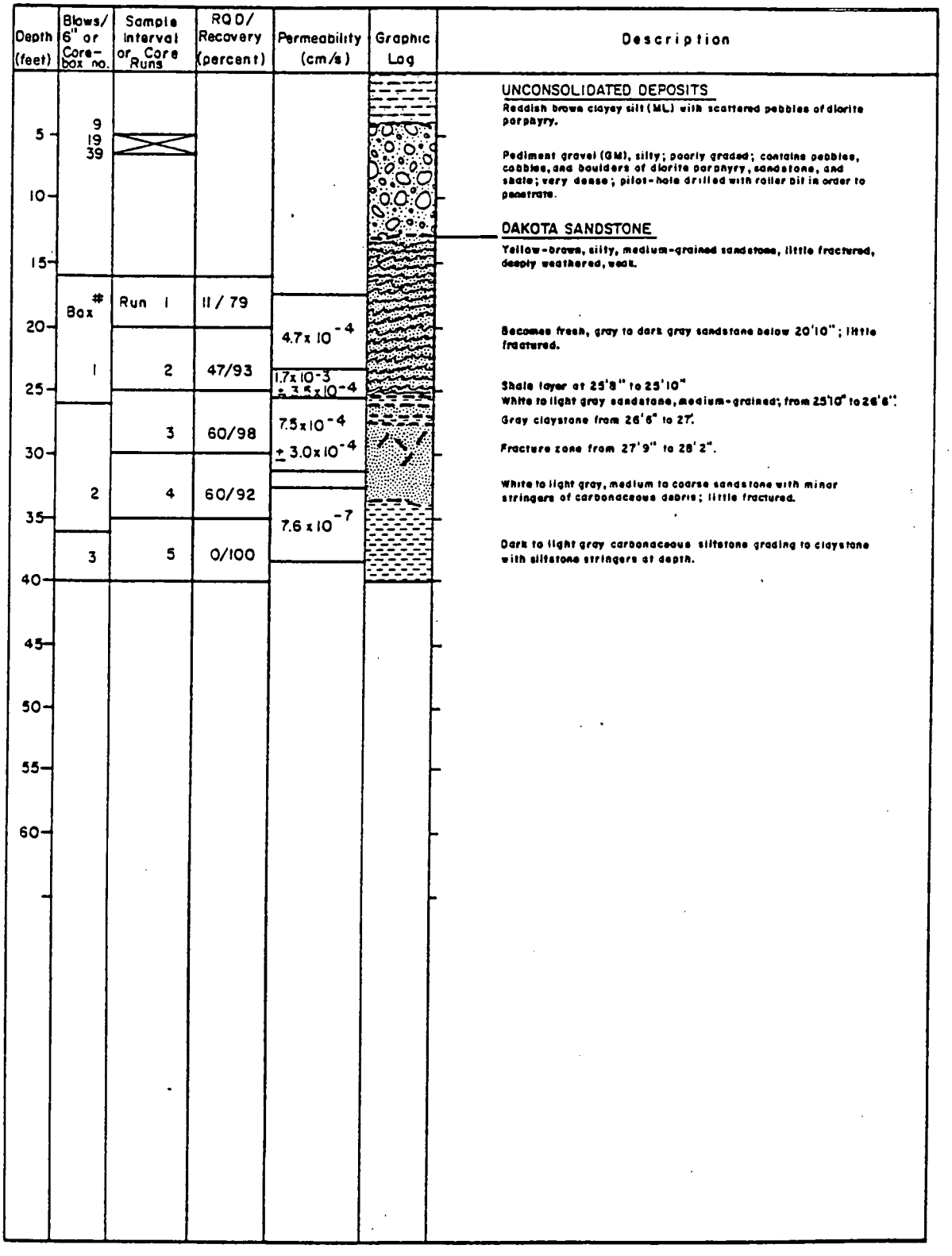


Figure 9. Geotechnical Log of Borehole 85-29

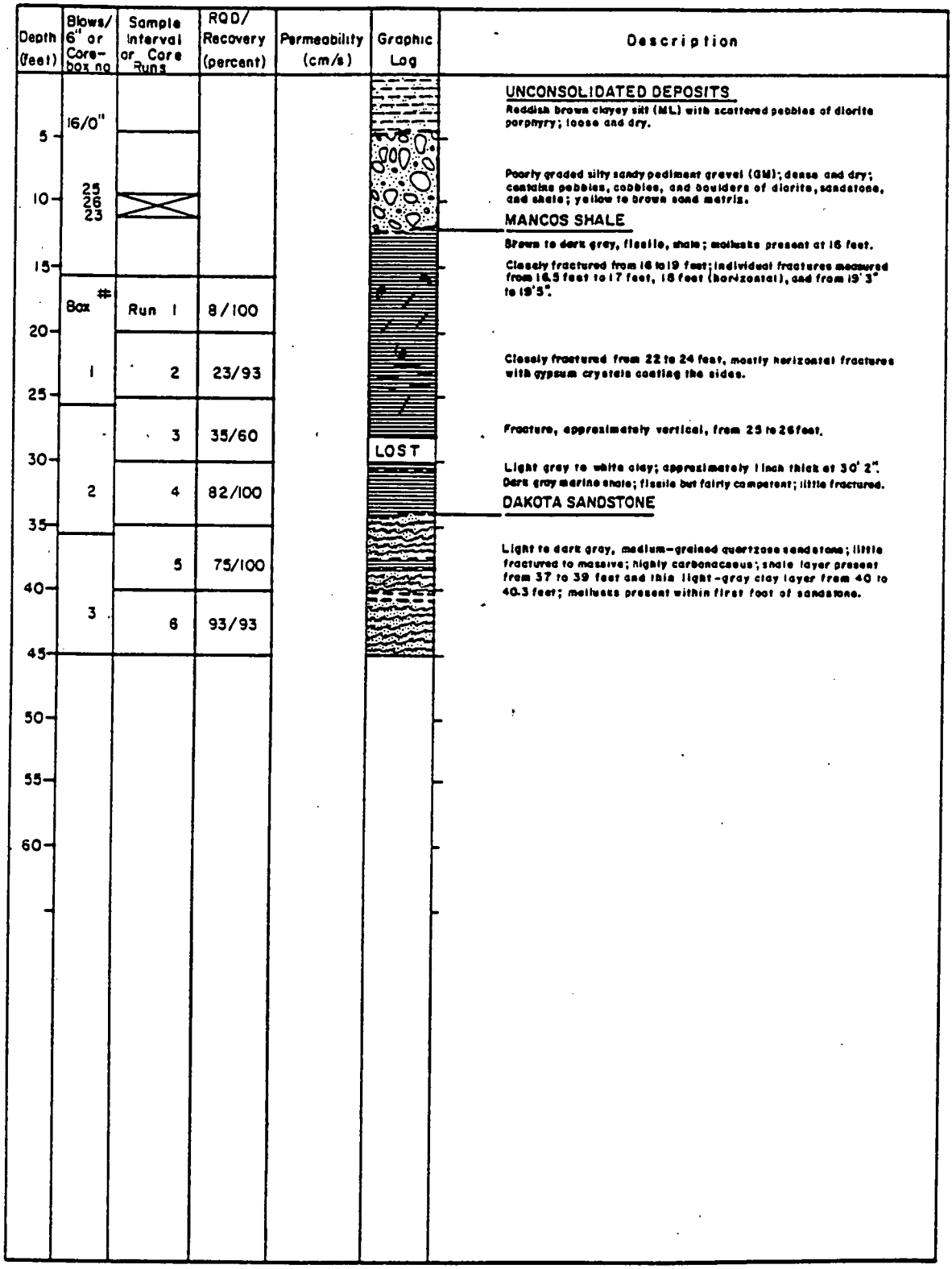


Figure 10. Geotechnical Log of Borehole 85-30

Appendix B

BOREHOLE GEOPHYSICAL LOGS AND DATA

Three logging systems were used at the Monticello, Utah, site—two total-count tools (PRS-1 RASCAL) and a spectral tool (Compulogger). Only the main log is presented in this appendix, since the main and repeat logs agree. Borehole data with each system, in cased boreholes, are presented below. Equipment characteristics and calibration information are included to document the parameters used in data reduction.

Uncertainties for the total-count system were calculated at a 95 percent confidence level (2σ). Water was not encountered in several boreholes as indicated by the fluid-level depth of 99.0 feet, a default value, shown in the tables and on the geophysical logs. The auger height shown on each log indicates the distance measured from the top of the auger to the ground surface.

LOGGING EQUIPMENT DATA

INSTRUMENT	COMPULOGGER	CASING FACTOR*	1.33 ± 0.01	
GJO NUMBER	C-1815S	FLUID FACTOR†	1.10 ± 0.07	
SERIAL NUMBER	230-01	MOISTURE FACTOR‡	1.10 ± 0.01	
DETECTOR	NaI(Tl)	K FACTOR (Ra-226)§	7.61 ± 0.22	g-cps/pCi (Ra-226)
DETECTOR SIZE	2 in. x 6 in.	BACKGROUND COUNT RATE	30.05 ± 12.25	cps_i
PROBE DIAMETER	2.65 in.	ALPHA FACTOR	3.20 ± 0.32	ft^{-1}
CALIBRATION DATE	23 August 1985			

INSTRUMENT	PRS-1/SPA-3	CASING FACTOR*	1.73 ± 0.02	
GJO NUMBER	C-3572S	FLUID FACTOR†	1.04 ± 0.07	
SERIAL NUMBER	753	MOISTURE FACTOR‡	1.10 ± 0.01	
DETECTOR	NaI(Tl)	K FACTOR (Ra-226)§	79.87 ± 1.36	g-cps/pCi (Ra-226)
DETECTOR SIZE	2 in. x 2 in.	BACKGROUND COUNT RATE	195.23 ± 76.61	cps_i
PROBE DIAMETER	2.5 in.	ALPHA FACTOR	3.20 ± 0.32	ft^{-1}
CALIBRATION DATE	23 August 1985			

INSTRUMENT	PRS-1/SPA-3	CASING FACTOR*	1.69 ± 0.02	
GJO NUMBER	C-3958S	FLUID FACTOR†	1.05 ± 0.03	
SERIAL NUMBER	813	MOISTURE FACTOR‡	1.10 ± 0.01	
DETECTOR	NaI(Tl)	K FACTOR (Ra-226)§	76.72 ± 0.89	g-cps/pCi (Ra-226)
DETECTOR SIZE	2 in. x 2 in.	BACKGROUND COUNT RATE	194.31 ± 53.89	cps_i
PROBE DIAMETER	2.5 in.	ALPHA FACTOR	3.20 ± 0.32	ft^{-1}
CALIBRATION DATE	22 August 1985			

*Based on casing thickness of 0.25 in.

†Based on hole diameter of 4.5 in.

‡Based on average subsurface moisture content of 9.1 ± 4.2 percent.

§Based on average Th-232 concentration of 10.0 ppm and average K concentration of 2.0 percent.

APPARENT RADIUM-226 CONCENTRATION MRP-001

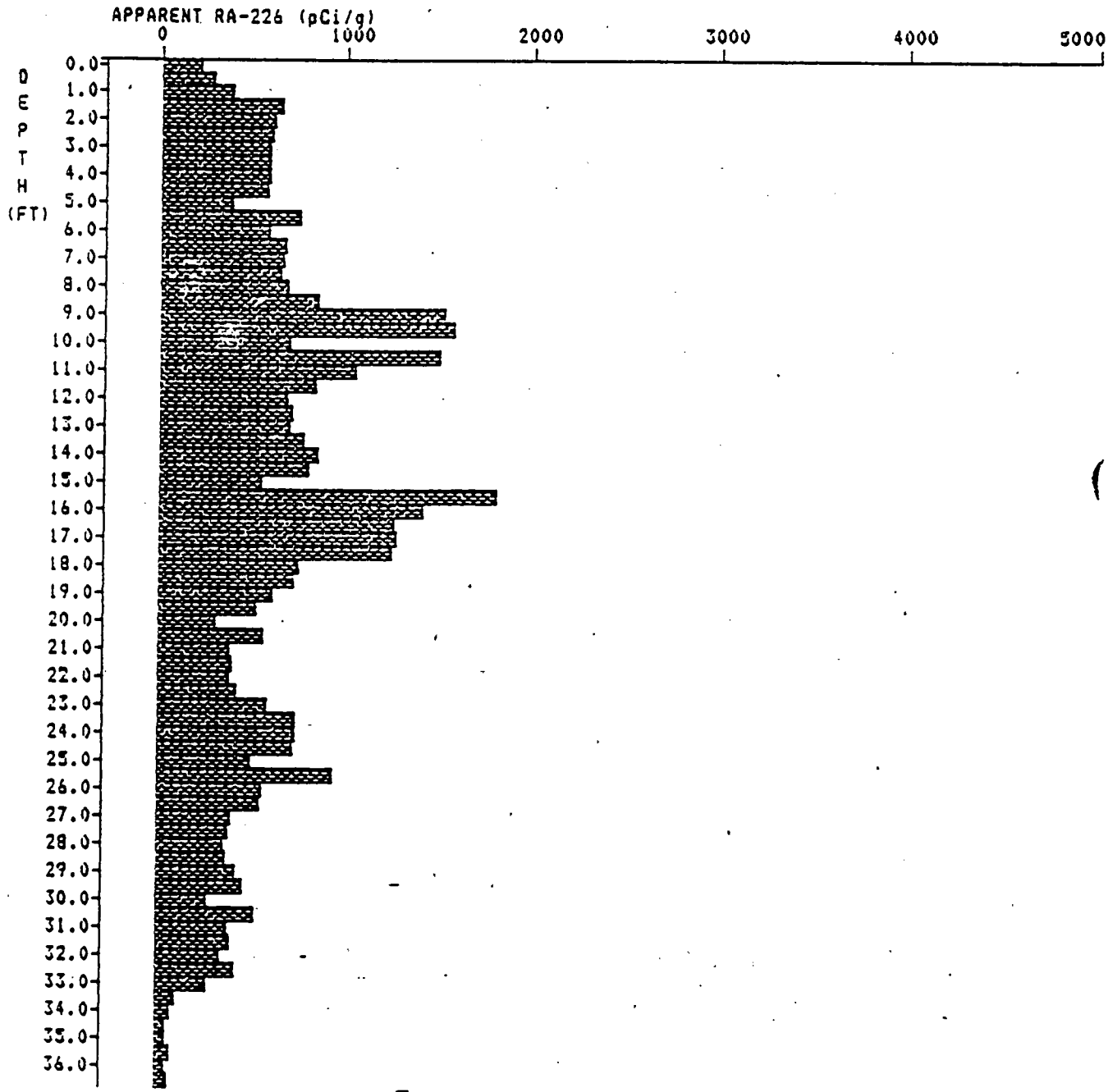
PROJECT: M R A P

START DATE: 850903

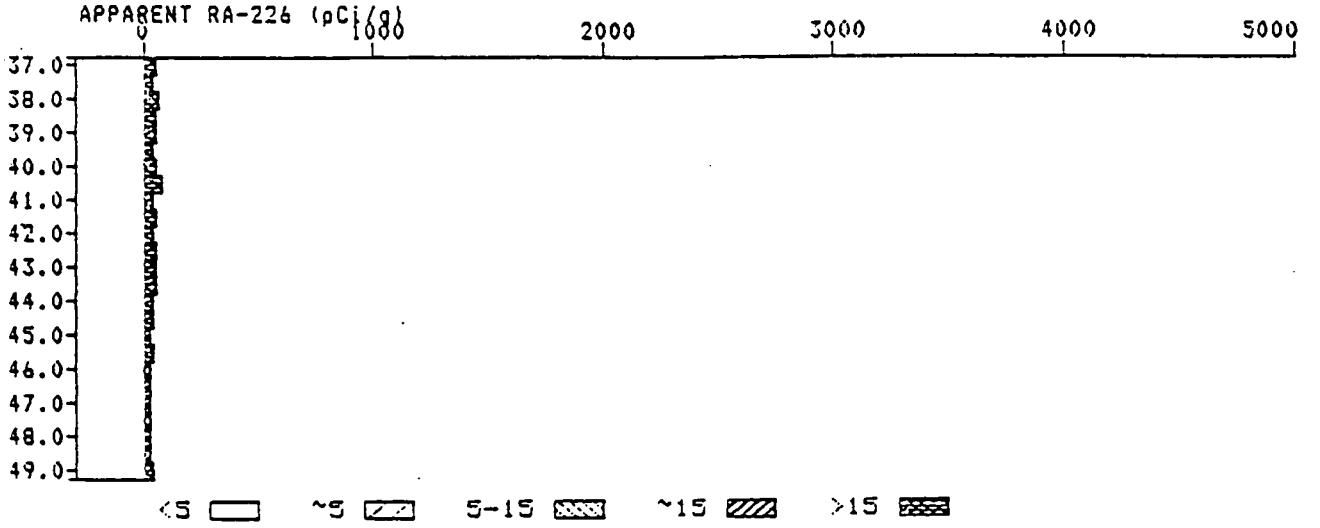
HOLE NUMBER: 001
LOCATION: 11060.0N 21250.0E
FLUID LEVEL: 36.5 FT.
PHASE: 1

DATE DRILLED: 850903
ELEVATION: 6897.2 FT.
AUGER HEIGHT: 54.0 IN.

INSTRUMENT TYPE: COMPULOGGER SERIAL NO. 230-01 GJO NO.: C-1815S



APPARENT RADIUM-226 CONCENTRATION MRP-001



APPARENT RADIUM-226 CONCENTRATION MRP-001

Depth (ft)	Observed Count Rate (cps)		Apparent Radium-226 (pCi/g)	2-Sigma Uncertainty (pCi/g)
0.0	1193.5		208.6	14.5
0.5	1399.7	>	283.6	22.3
1.0	2351.0	>	385.2	28.5
1.5	3501.3	>	647.7	51.6
2.0	3693.1	>	608.9	49.7
2.5	3584.8	>	596.4	47.0
3.0	3513.2	>	581.8	45.9
3.5	3483.6	>	580.7	45.8
4.0	3452.7	>	579.7	45.8
4.5	3330.1	>	574.7	47.2
5.0	2703.0	>	376.4	63.0
5.5	3019.6	>	744.3	77.6
6.0	3642.6	>	582.2	52.0
6.5	3872.9	>	663.1	44.1
7.0	3978.3	>	661.2	41.1
7.5	3994.6	>	643.7	41.1
8.0	4346.0	>	679.5	47.6
8.5	5507.0	>	841.7	64.8
9.0	8107.1	>	1522.6	125.2
9.5	8580.7	>	1569.1	120.8
10.0	5657.3	>	694.7	174.1
10.5	5791.8	>	1487.7	177.6
11.0	6336.5	>	1047.4	94.4
11.5	5118.1	>	830.1	58.7
12.0	4328.5	>	686.6	47.1
12.5	4204.5	>	703.0	43.8
13.0	4245.2	>	687.6	43.4
13.5	4568.4	>	768.1	47.0
14.0	4904.5	>	841.2	52.4
14.5	4834.7	>	795.7	50.0
15.0	4517.3	>	649.5	139.4
15.5	6821.5	>	1792.6	217.9
16.0	8425.5	>	1408.4	120.1
16.5	7700.0	>	1257.6	82.9
17.0	7421.6	>	1262.7	78.0
17.5	6952.7	>	1243.1	85.6
18.0	5083.5	>	749.5	69.5
18.5	4221.6	>	720.3	49.2
19.0	3684.5	>	612.0	38.7
19.5	3060.9	>	516.4	32.8
20.0	2802.9	>	504.4	32.1
20.5	2591.7	>	562.1	61.8
21.0	2456.4	>	386.2	38.9
21.5	2309.0	>	387.7	27.2
22.0	2364.1	>	375.3	28.5
22.5	2646.6	>	413.1	29.5
23.0	3430.5	>	583.6	36.9
23.5	4173.4	>	726.8	47.2
24.0	4354.8	>	735.7	45.6
24.5	4186.3	>	719.5	45.9
25.0	4222.4	>	497.2	72.2
25.5	6621.6	>	930.0	106.2
26.0	6630.8	>	556.0	63.2
26.5	5108.3	>	588.4	40.7
27.0	3655.2	>	393.9	30.6
27.5	3318.8	>	386.4	28.4
28.0	3333.7	>	362.3	28.6
28.5	3333.0	>	364.1	28.7
29.0	2461.6	>	420.0	27.0
29.5	2545.6	>	452.6	27.2
30.0	1983.5	>	273.9	47.2
30.5	2081.9	>	514.9	35.4
31.0	2379.4	>	382.2	34.6
31.5	2300.6	>	389.5	26.7
32.0	2179.8	>	345.8	33.8
32.5	2245.0	>	421.4	36.3
33.0	1651.5	>	270.2	20.3
33.5	801.3		99.2	18.1
34.0	441.1		65.8	8.9
34.5	329.8		47.7	5.8
35.0	281.2		40.9	6.1
35.5	390.1		67.7	8.3
36.0	305.9		42.1	6.8
36.5	289.6		38.5	8.6

APPARENT RADIUM-226 CONCENTRATION MRP-001

Depth (ft)	Observed Count Rate (cps)	Apparent Radium-226 (pCi/g)	2-Sigma Uncertainty (pCi/g)
37.0	269.1	45.0	8.0
37.5	232.4	38.0	7.7
38.0	278.4	50.5	8.8
38.5	281.8	47.3	8.2
39.0	264.3	45.4	7.7
39.5	238.5	36.8	7.2
40.0	256.9	38.8	7.9
40.5	260.3	69.0	11.5
41.0	249.5	35.0	9.1
41.5	244.8	44.0	7.6
42.0	237.1	37.1	7.0
42.5	248.8	43.0	7.2
43.0	257.6	45.3	7.4
43.5	253.4	37.9	6.8
44.0	213.1	36.8	6.4
44.5	176.1	26.5	5.6
45.0	148.9	24.1	5.3
45.5	129.9	30.0	5.7
46.0	121.7	15.2	4.9
46.5	126.0	20.7	4.4
47.0	127.4	19.4	4.2
47.5	121.7	17.8	4.1
48.0	124.6	19.6	4.2
48.5	121.2	13.0	5.0
49.0	188.0	30.6	4.0

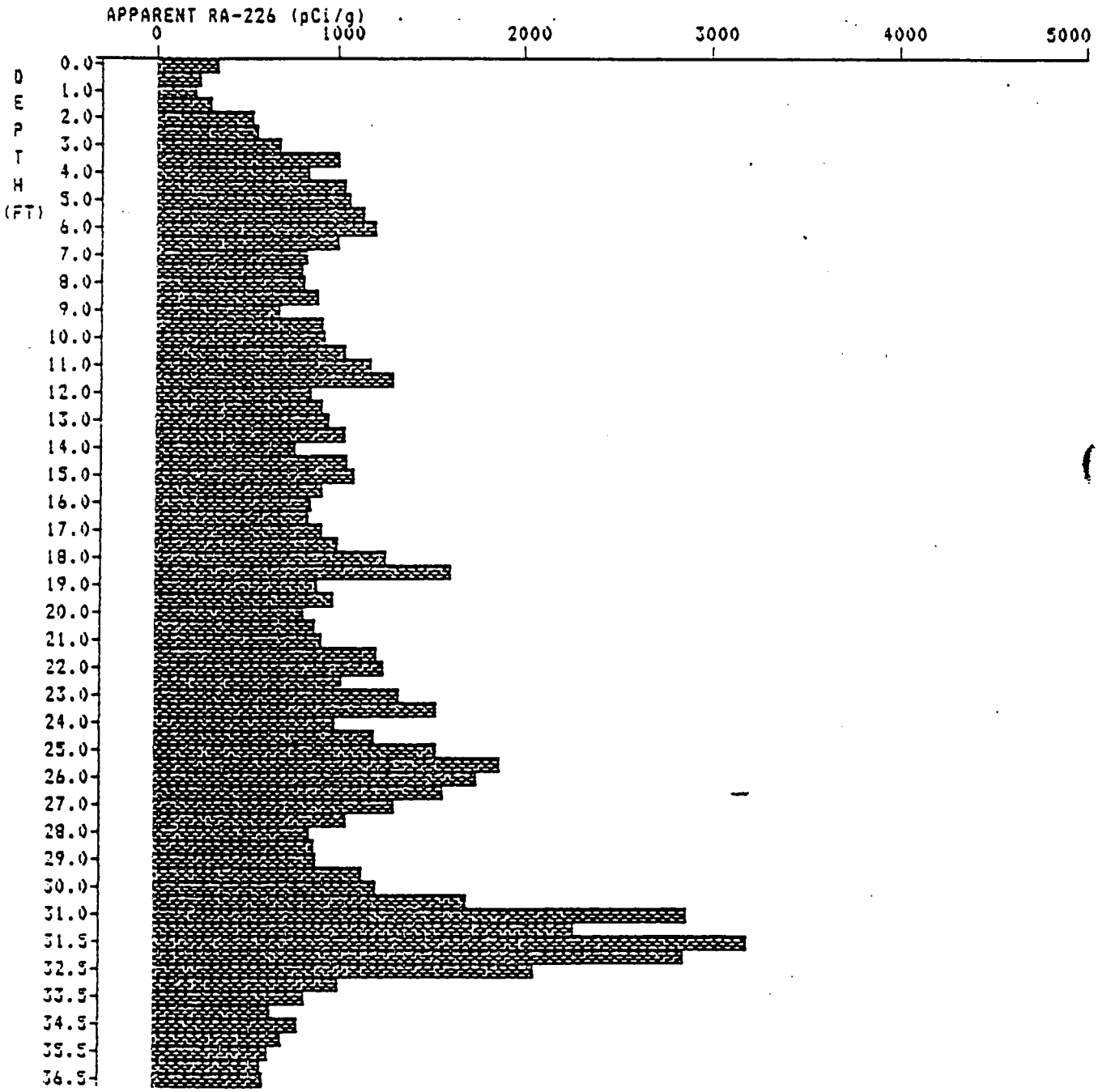
This data generated by LOGCALC.BAS Version 2.2 S/N 008

APPARENT RADIUM-226 CONCENTRATION MRP-002

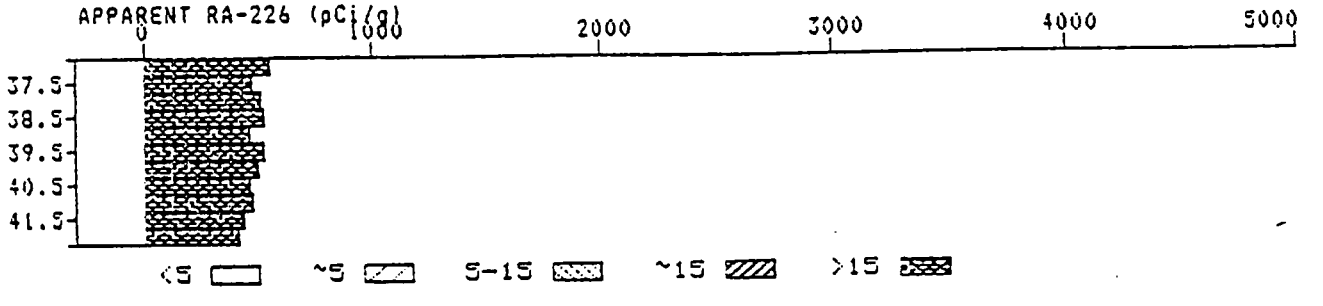
PROJECT: M R A P
START DATE: 850903

HOLE NUMBER: 002
LOCATION: 10880.0N 21300.0E
FLUID LEVEL: 11.5 FT.
PHASE: 1
DATE DRILLED: 850904
ELEVATION: 6898.5 FT.
AUGER HEIGHT: 16.0 IN.

INSTRUMENT TYPE: COMPULOGGER SERIAL NO. 230-01 GJO NO.: C-1815S



APPARENT RADIUM-226 CONCENTRATION MRP-002



APPARENT RADIUM-226 CONCENTRATION MRP-002

Depth (ft)	Observed Count Rate (cps)	Apparent Radium-226 (pCi/g)	2-Sigma Uncertainty (pCi/g)
0.0	2021.6	> 334.7	20.2
0.5	1532.5	> 228.3	19.2
1.0	1418.0	> 204.8	20.4
1.5	1890.1	> 288.0	20.8
2.0	2911.0	> 524.5	38.8
2.5	3454.1	> 547.5	37.2
3.0	4098.1	> 673.5	45.4
3.5	4341.8	> 988.5	85.9
4.0	4838.6	> 825.5	85.6
4.5	5946.1	> 1038.2	70.1
5.0	6384.5	> 1059.3	64.6
5.5	6673.7	> 1125.1	67.5
6.0	6829.9	> 1198.0	77.1
6.5	6054.4	> 991.3	60.9
7.0	5131.4	> 821.3	52.6
7.5	4843.9	> 799.8	48.9
8.0	4792.9	> 811.4	51.8
8.5	4029.7	> 875.5	69.1
9.0	4062.9	> 664.6	77.5
9.5	5145.2	> 905.1	64.1
10.0	5641.1	> 919.8	57.6
10.5	6179.4	> 1032.0	61.9
11.0	6831.5	> 1164.1	76.0
11.5	6486.4	> 1289.2	162.7
12.0	5204.9	> 841.9	143.0
12.5	4910.8	> 904.9	127.1
13.0	5058.2	> 937.7	130.3
13.5	4299.1	> 1035.0	145.2
14.0	4274.2	> 762.0	142.7
14.5	5359.0	> 1046.9	142.2
15.0	5693.7	> 1082.4	144.6
15.5	5110.9	> 908.5	129.9
16.0	4681.8	> 838.6	119.1
16.5	4644.9	> 827.8	117.3
17.0	5008.3	> 907.3	125.1
17.5	5620.1	> 998.3	140.2
18.0	6589.8	> 1251.4	168.9
18.5	6174.0	> 1604.3	227.4
19.0	5158.0	> 885.2	185.5
19.5	5032.4	> 965.4	139.7
20.0	4664.8	> 802.6	121.9
20.5	4760.2	> 867.0	120.3
21.0	5183.0	> 904.0	130.6
21.5	6245.8	> 1210.2	159.3
22.0	6624.6	> 1249.2	166.5
22.5	6140.4	> 1016.6	160.0
23.0	6840.8	> 1329.4	179.8
23.5	6157.5	> 1526.9	212.9
24.0	5661.4	> 984.9	196.1
24.5	6615.2	> 1189.3	173.1
25.0	8239.8	> 1555.0	208.0
25.5	9641.1	> 1872.8	245.4
26.0	9441.9	> 1745.0	237.0
26.5	8475.4	> 1573.7	215.2
27.0	7150.0	> 1300.6	182.9
27.5	5842.2	> 1046.9	150.9
28.0	4817.6	> 846.9	129.8
28.5	4869.0	> 871.8	129.3
29.0	4572.0	> 883.4	141.6
29.5	6066.0	> 1125.4	153.0
30.0	7172.0	> 1208.2	184.2
30.5	9672.0	> 1693.8	241.6
31.0	13855.0	> 2873.3	382.9
31.5	13855.0	> 2274.8	371.6
32.0	15774.0	> 3191.6	427.6
32.5	15009.0	> 2861.4	386.0
33.0	11130.0	> 2051.3	291.5
33.5	6418.0	> 1007.3	205.2
34.0	3656.0	> 815.4	136.5
34.5	3409.0	> 631.8	113.5
35.0	3980.0	> 779.5	106.8
35.5	3823.0	> 694.5	97.0
36.0	3439.0	> 617.8	87.5
36.5	3218.0	> 579.5	81.6
37.0	3162.0	> 589.9	80.2

Appendix C

BOREHOLE AND TEST-PIT GEOTECHNICAL DATA

Geotechnical analyses were performed on selected borehole and test-pit samples by Goodson and Associates, Inc., of Lakewood, Colorado. Proctor tests and specific gravity for tailings and borrow soils were performed by Rogers and Associates Engineering Corporation, Salt Lake City, Utah.

GOODSON & ASSOCIATES, INC.
11949 West Colfax Avenue
Lakewood, Colorado 80215

December 20, 1985

G&AI PROJECT NO: 6411.01

SUMMARY OF LABORATORY TEST RESULTS

MKB No.	Location	Depth (Feet)	Nat. Moist. (%)	Nat. Dry Density (PCF)	Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	ASTM D-698 Density/ Moisture	Specific Gravity	Soil Description/ USCS
652	85-01	6-8'	4.6	89.6			3		NP		2.57	silty clay (CL-ML)
661	85-02	2-4'	4.0	107.5			49		NP		2.60	very silty sand (SM)
787	85-02	1'					66			114.7/14.5		sandy silt (ML)
749	85-03	2-4'	27.4	92.1			84	20	4		2.67	slightly clayey silt (ML)
682	85-04	4-6'	39.8	80.7			44	27	10		2.62	sandy clay (CL)
783	85-04	1'					71			114.3/13.7		sandy silt (SM)
678	85-05	6-8'	41.7	76.1			94	21	5		2.63	clayey silt (CL-ML)
689	85-06	2-4'	5.2	96.4			42		NP		2.67	very silty sand (SM)
779	85-06	1'					52			111.2/14.1		sandy silt (ML)
697	85-07	2-4'	9.9	94.0			19		NP		2.61	silty sand (SM)
714	85-08	12-14'	34.4	108.6			81	41	22		2.70	sandy clay (CL)
706	85-09	4-6'	21.4	100.7			88	42	13		2.63	sandy clay (CL)
723	85-10	4-6'	43.5	66.1			78	29	11		2.63	sandy clay (CL)
791	85-10	1'					49			111.8/16.9		silty sand (SM)
741	85-11	4-6'	39.8	74.8			72	44	20		2.69	sandy clay (CL)
732	85-12	4-6'	40.5	76.4			87	47	10		2.68	slightly sandy silt (ML)

COODSON & ASSOCIATES, INC.
11949 West Colfax Avenue
Lakewood, Colorado 80215

December 20, 1985

C&AI PROJECT NO: 6411.01

SUMMARY OF LABORATORY TEST RESULTS

NKB No.	Location	Depth (Feet)	Nat. Moist. (%)	Nat. Dry Density (PCF)	Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	ASTM D-698 Density/ Moisture	Specific Gravity	Soil Description/ USCS
834	85-15	2-37'	6.9				82			102.5/19.7		slightly sandy, clayey silt (ML)
835	85-16	5.5-12'	13.2				82			113.7/14.9	2.65	gravelly silt (ML)
776	85-16	9-10'	11.8	121.0			79	36	14		2.61	sandy clay (CL)
766	85-17	0-2'	48.2				31	33	10		2.63	clayey sand (SC)
830	85-17	0-5'			13	6	81			108.3/17.0		gravelly silt (ML)
768	85-18	0-2'	14.3				65	32	14		2.55	sandy clay (CL)
833	85-18	0-5'					80			103.3/19.0		sandy silt (ML)
759	85-19	0-2'	5.8				70	26	6		2.61	sandy clayey silt (CL-ML)
828	85-19	0-5'					73			109.8/15.8		sandy silt, organics (ML-OL)
753	85-20	0-2'	10.8				80	41	7		2.62	sandy silt, organics (OL)
836	85-20	0-3'					71			101.9/18.9		gravelly silt, (topsoil, OL)
756	85-21	0-2'	7.5					30	10		2.60	silty sand, (topsoil, OL)
826	85-21	0-3'					43			115.2/13.6		silty sand (SM)
841	+0	0-2'			19	52	29				2.54	gravelly, silty sand, organics (SM)

GOODSON & ASSOCIATES, INC.
11949 West Colfax Avenue
Lakewood, Colorado 80215

December 20, 1985

C&AI PROJECT NO: 6411.01

SUMMARY OF LABORATORY TEST RESULTS

MKB No.	Location	Depth (Feet)	Nat. Moist. (%)	Nat. Dry Density (PCF)	Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	ASTM D-698 Density/ Moisture	Specific Gravity	Soil Description USCS
842	+1000	0-2'			56	40	4				2.65	sandy gravel (GP) organics
843	+2000	0-2'			0	39	61				2.61	very silty sand (SM) organics
840	+3500	0-1.5'			2	39	59				2.66	sandy silt (ML) organics
839	+5000	0-2'			10	40	50				2.58	gravelly sandy silt (ML) organics
838	+6500	0-1.5'			15	38	47				2.65	gravelly, sandy silt (ML) organics

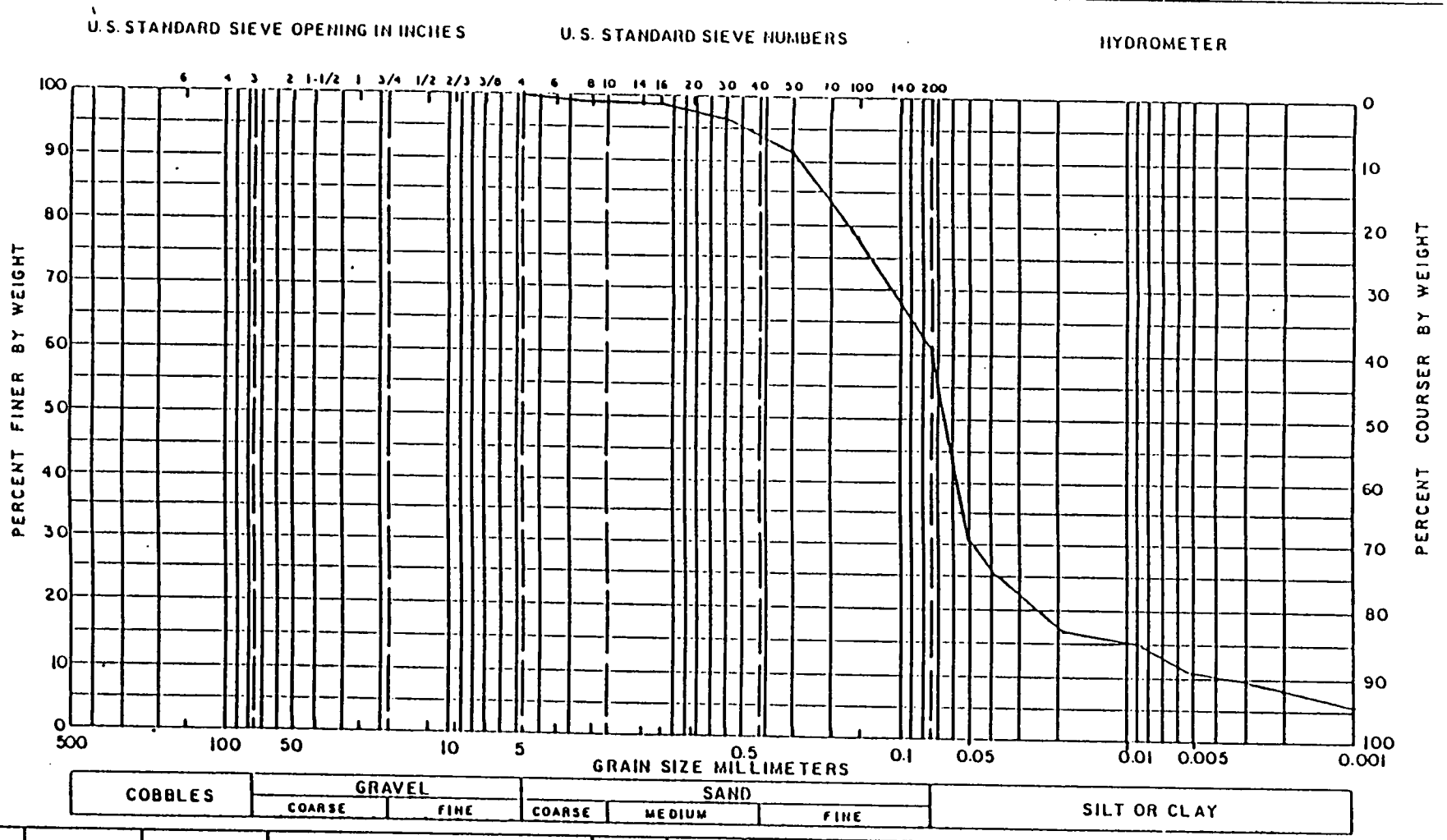
ROGERS AND ASSOCIATES ENGINEERING CORP.

May 7, 1986

SUMMARY OF GEOTECHNICAL TEST RESULTS

on BFEC Uranium Mill Tailings and Borrow Soil Samples

Samole	Standard Proctor Test (ASTM-D698)		Specific Gravity (ASTM-D854) (g/cm^3)
	Ootimum Moisture	Max. Dry Density	
MKB-780	15.3	107.1	--
MKB.782	15.5	103.6	2.70
MKB-784	13.2	107.6	2.67
MKB-786	15.3	113.8	2.60
MKB-788	13.0	102.9	--
MKB-790	28.3	94.6	2.70
MKB-792	12.4	110.4	--
MKB-793	26.3	94.5	2.76
MKB-834	--	---	2.66



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	W_n	W_L	W_p	PI
+2000	NKB-843	0-2'	silty, slightly gravely, sand				

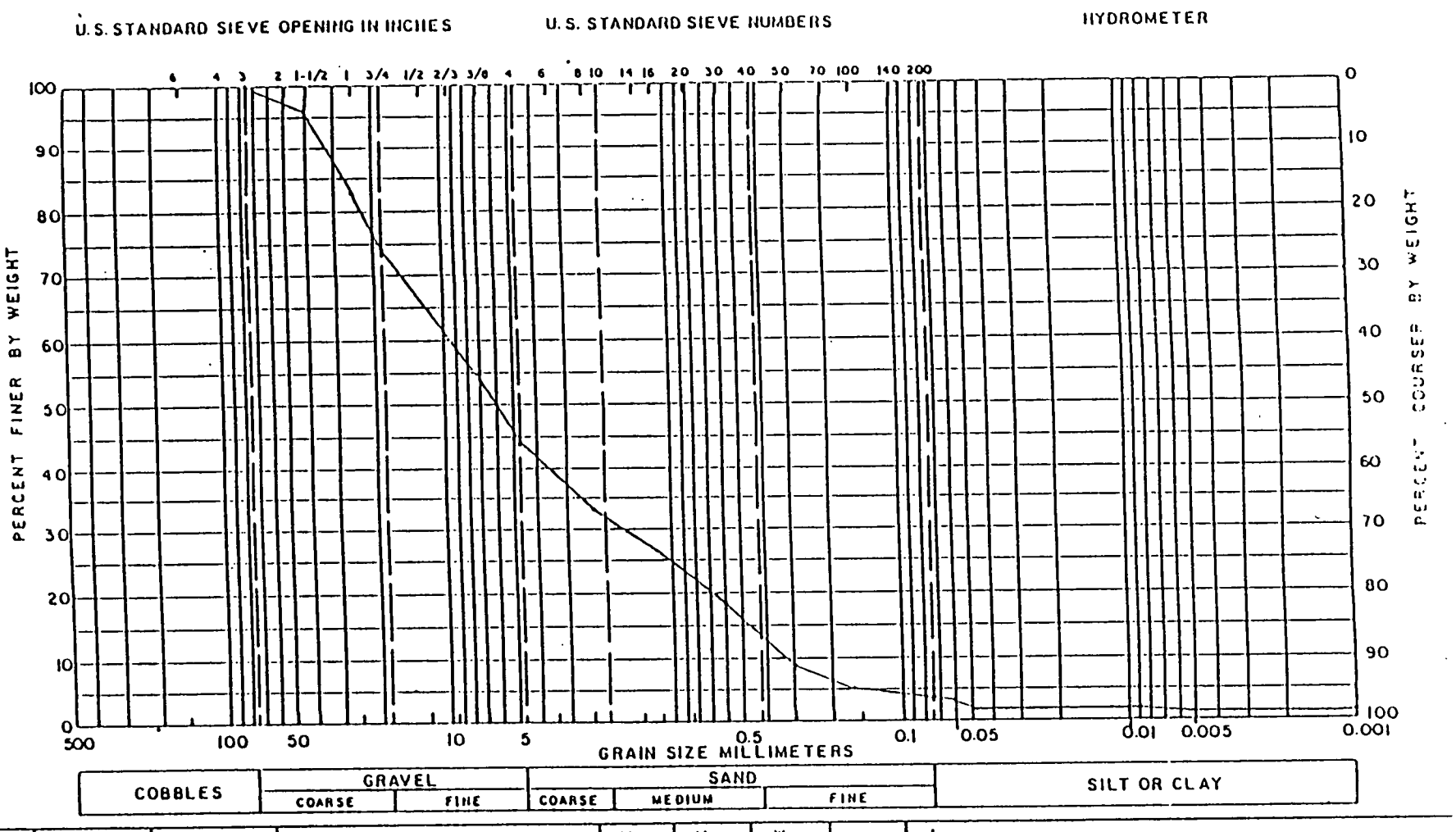
Drawn by:
Engr.
Revised:

PROJECT NO. 6411.01 DWG. NO.

GRADATION CURVES

Bendix Corporation

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	W_n	W_L	W_p	PI
+1000	MKB-842	0-2'	sandy, slightly silty, gravel				

Drawn by:

Engr.

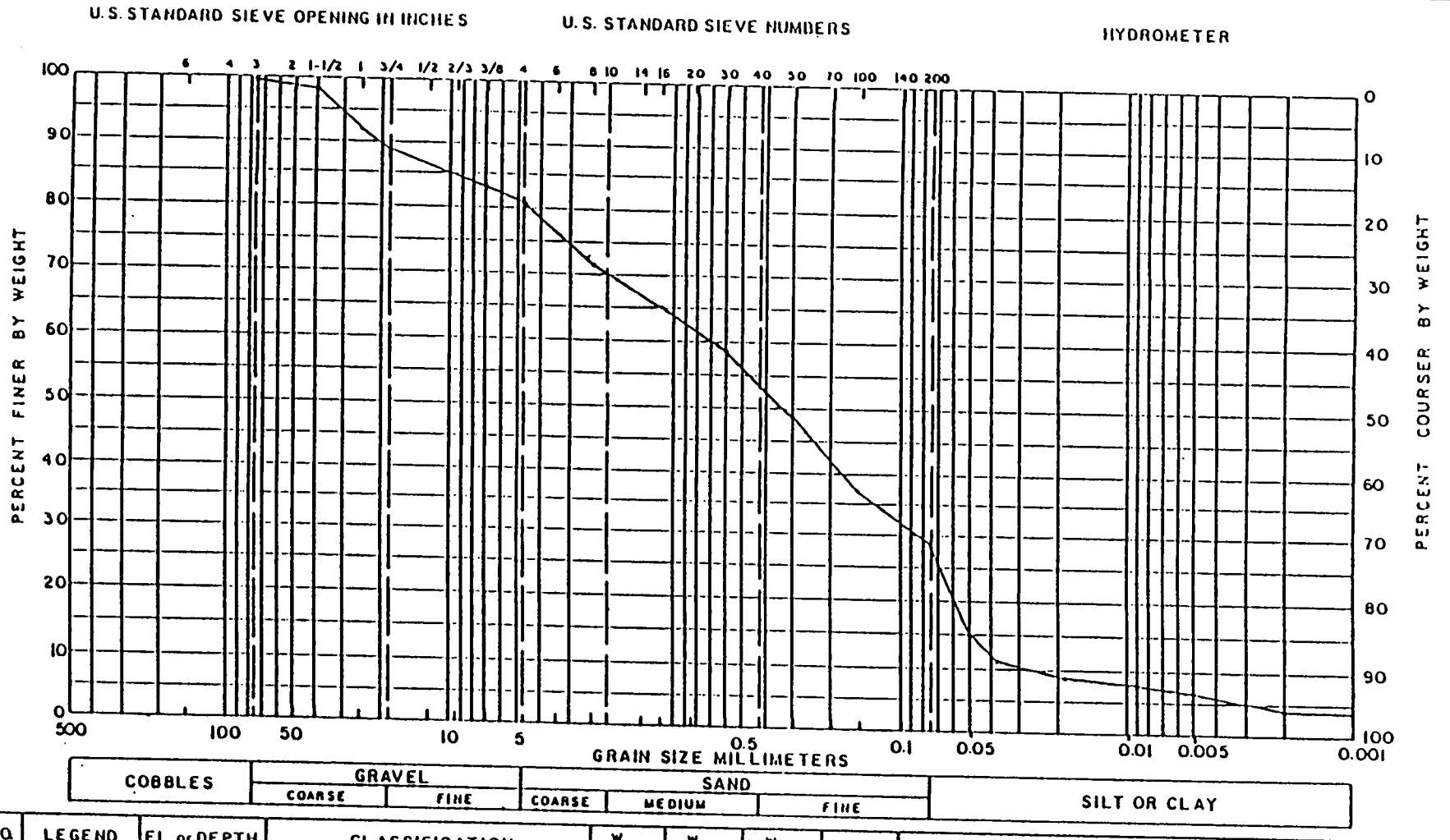
sed:

PROJECT NO. 6411.01 DWG. NO.

GRADATION CURVES

Bendix Corporation

GOODSON & ASSOCIATES, INC
CONSULTING ENGINEERS



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
+0	MKB-841	0-2'	silty, gravely, sand				

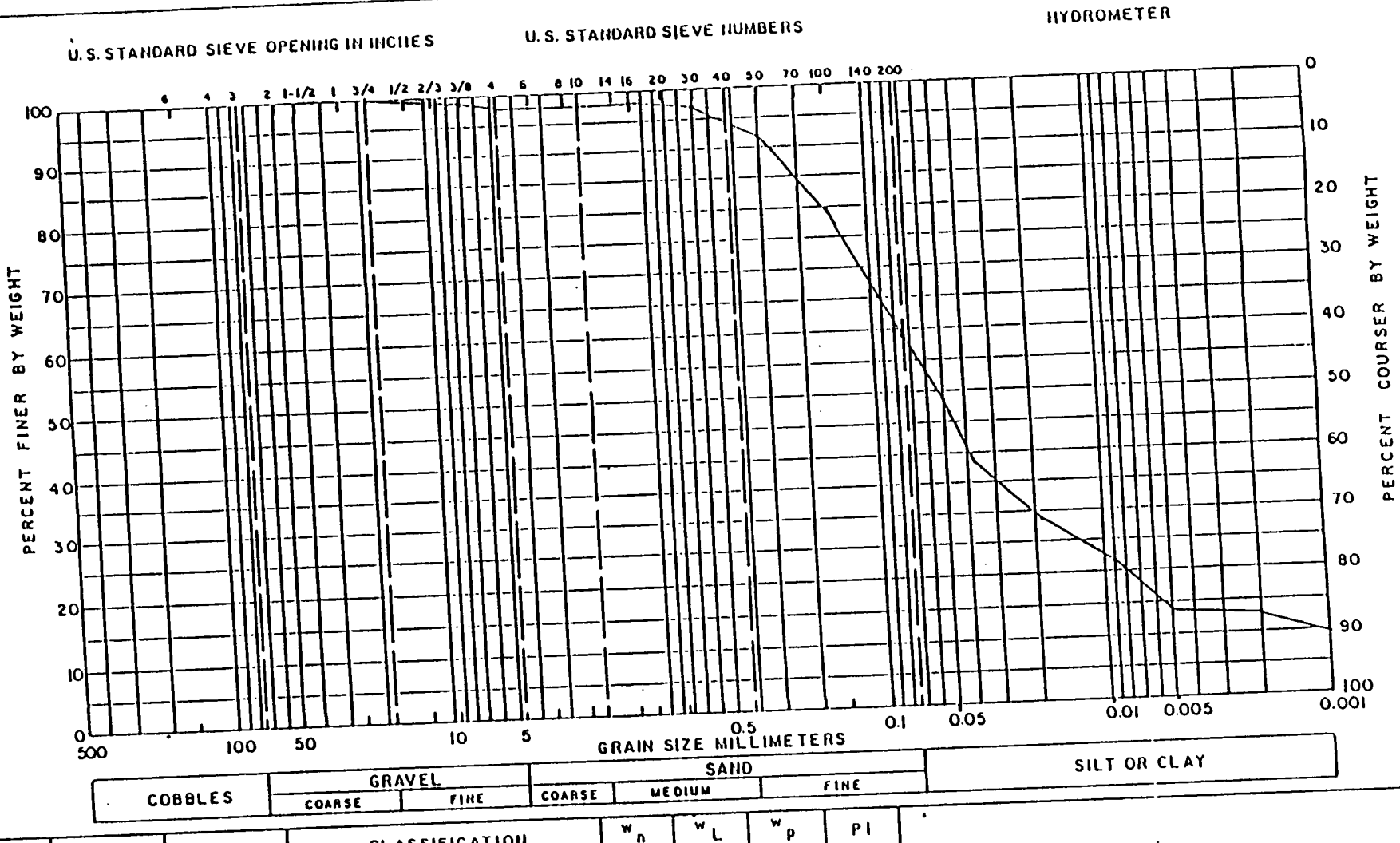
Drawn by:
Engr.
Revised:

PROJECT NO. 6411.01 DWG. NO.

GRADATION CURVES

Bendix Corporation

GOODSON & ASSOCIATES, INC
CONSULTING ENGINEERS



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
+3500	MKB-840	0-1.5'	sandy, slightly gravely silt				

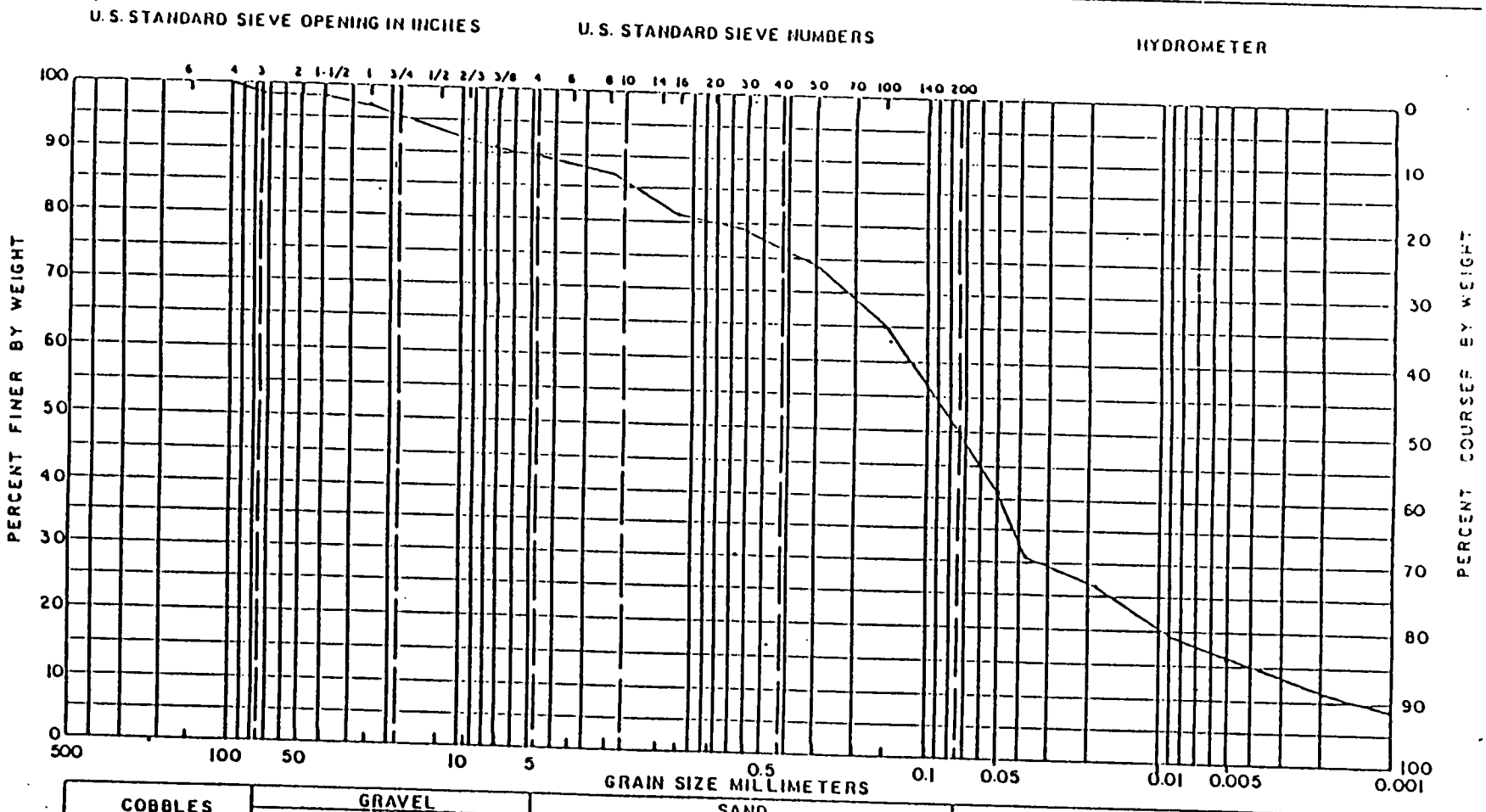
Drawn by:
Engr.
Used:

PROJECT NO. 6411.01 | DWG. NO.

GRADATION CURVES

Bendix Corporation

GOODSON & ASSOCIATES, INC.
CONSULTING ENGINEERS



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
+5000	NKB-839	0-2'	sandy, gravely silt				

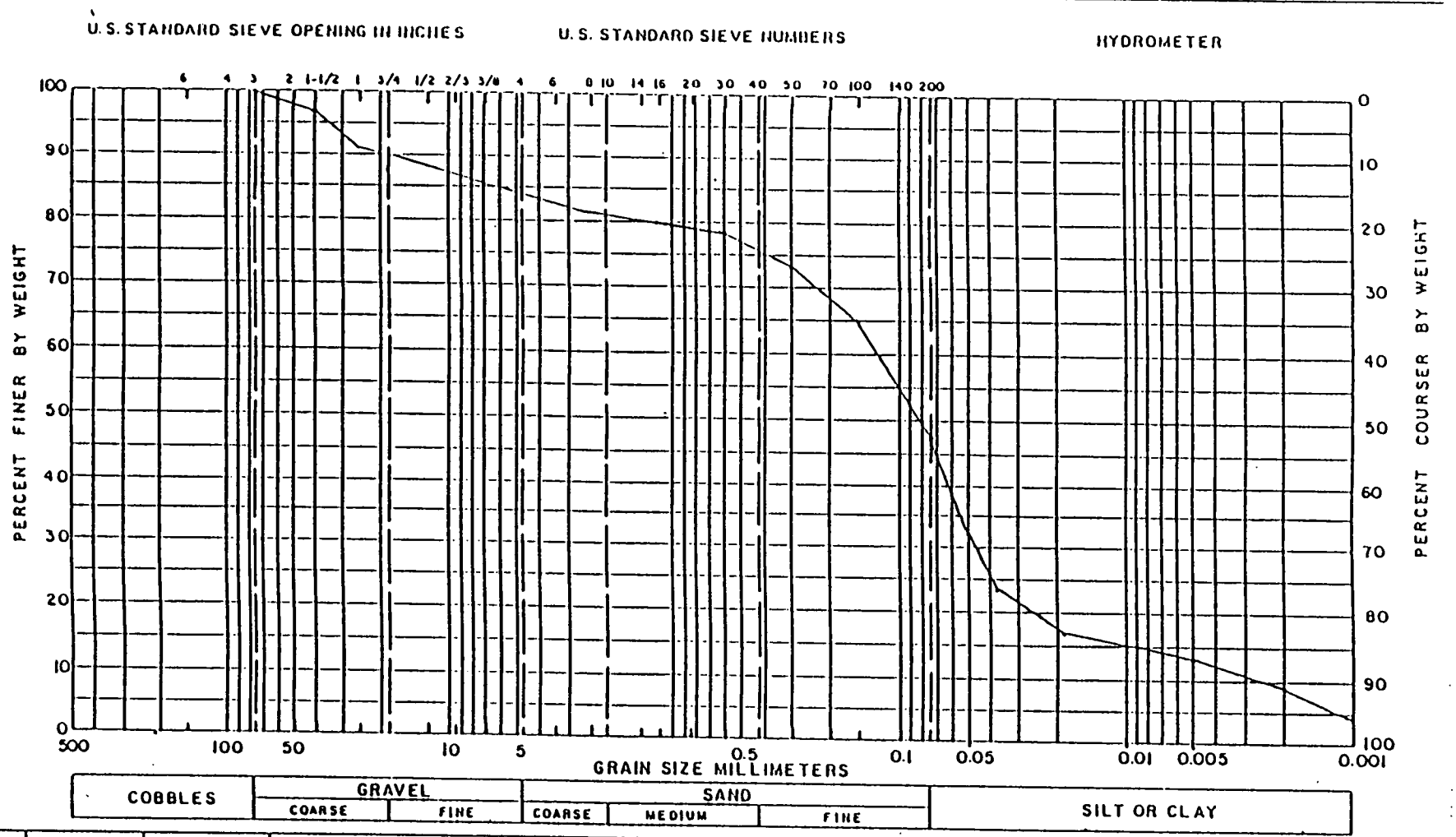
Drawn by:
Engr.
Revised:

PROJECT NO. 6411.01 | DWG. NO.

GRADATION CURVES

Bendix Corporation

GOODSON & ASSOCIATES, INC
CONSULTING ENGINEERS



BORING NO.	LEGEND	EL. or DEPTH	CLASSIFICATION	w_n	w_L	w_p	PI
+6500	MKB-838	0-1.5'	sandy, gravely, silt				

Drawn by:

Engr.

sed:

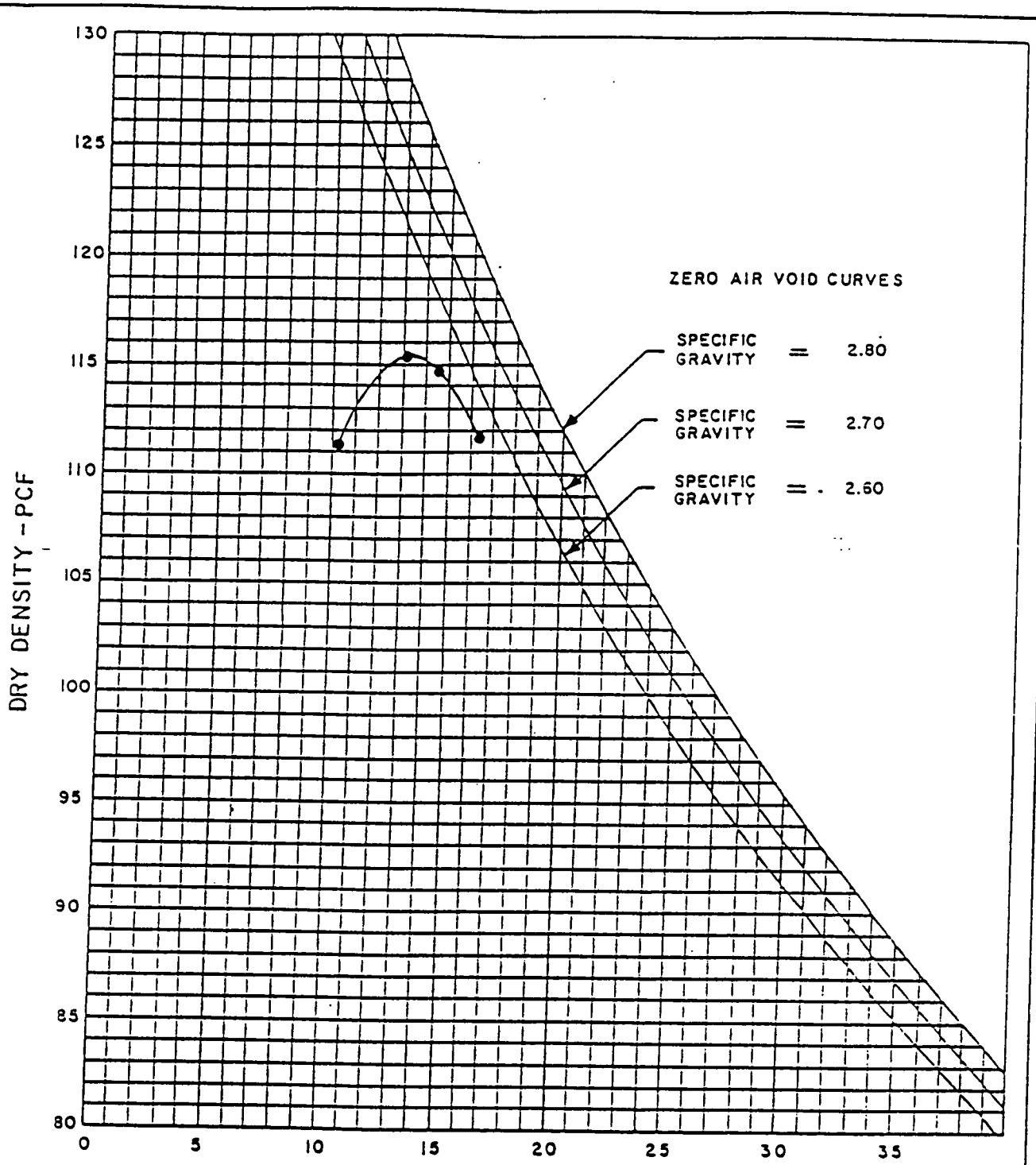
PROJECT NO. 6411.01

DWG. NO.

GRADATION C S

Bendix Corporation

GOODSON & ASSOCIATES, INC
CONSULTING ENGINEERS



LOCATION:	MOISTURE-DENSITY RELATIONSHIPS
HOLE NO.: 85-21 DEPTH: 0-3' SAMPLE NO.: MKB-826	
SOIL DESCRIPTION: Silty sand (SM)	GOODSON & ASSOC. INC.
MAX. DRY DENSITY: 115.2 PCF OPT. MOIST. CONTENT: 13.6 %	PROCEDURE: ASTM D-698 Method A
LIQUID LIMIT: PLASTICITY INDEX:	JOB NO.: 6411.01 FIG. NO.
GRAVEL: % SAND: % SILT AND CLAY(-200): 43 %	DATE: 09-16-85

APPENDIX H

EVALUATION CRITERIA AND MANDATORY MINIMUM REQUIREMENTS FOR SUBCONTRACTORS

EVALUATION CRITERIA AND MANDATORY MINIMUM
REQUIREMENTS FOR SUBCONTRACTORS

The bidding Subcontractor's shall furnish information sufficient to provide evaluation by the Contractor consistent with the following items.

The information submitted should identify which criteria are to be evaluated against the given Contractor submittals. All Evaluation Criteria should be addressed.

Subcontractor's must provide evidence of the items listed under Mandatory Minimum requirements to be further considered under the evaluation criteria. Subcontractor's not supplying evidence shall be considered technically non-responsive.

MANDATORY MINIMUM REQUIREMENTS

Personnel Health and Safety Plan

The Subcontractor must have previously written and implemented a Health and Safety plan. It should be adaptable to the project per paragraph 15 of the Statement of Work and Appendix D. Submit an example of a previously used plan with the proposal.

Quality Assurance/Quality Control

The Subcontractor must have previously written and implemented a QA/QC program/plan for both field and office activities. It should be adaptable to this project per paragraph 14 of the Statement of Work and Appendix E. This example program/plan shall be provided with the proposal.

Professional Licenses

Project Technical Manager must have a professional engineering license with the State of Utah and driller is licensed for water wells in the State of Utah per paragraph 16 of the Statement of Work.

Soils Laboratory

The Geotechnical Soils Laboratory must have a written and implemented QA/QC Plan per paragraph 11.3 of the Statement of Work and Appendix E. This plan is subject to approval by Geotech.

EVALUATION CRITERIA

Understanding of This Task

The information to be collected will be used as a primary source of data for geotechnical properties and contaminated material characterization of the millsite. Offerors must state clearly their understanding of the task and specific data usage. Offerors should state their intention and ability to provide the appropriate data. Considering the dynamics of a Geotechnical and radiologic and hazardous waste Investigation, discuss the criteria and methods to be used in making modifications to the drilling, sampling laboratory or data interpretation plans. Preferred maximum of 5 pages double spaced.

Technical References

Technical References

Provide a list of references (with name of contact and telephone numbers) for all jobs over $50,000 fee in the last 3 years (include other jobs if needed to meet a minimum of five references):

Company Prior Experience

Indicate the Company's (specific branch office that will perform the work) experience. Desired experience is in the areas of General Heavy Civil Design and Construction, Hazardous Waste Experience, and/or Low Level Radioactive Waste Experience. Indicate percentage of work the company performs in the area of geotechnical versus other fields.

Quality Assurance/Quality Control Plan

The existing QA/QC plan will be evaluated by the criteria as shown in Appendix E. Provide a brief summary of existing procedures adaptable to this project. In addition, discuss personnel structure and QA/QC philosophy. A more detailed conforming plan is preferred.

Health and Safety Plan

The existing Health and Safety Plan will be evaluated by how well it conforms to the criteria in Appendix D. Provide a brief summary of procedures adaptable to this project.

Work Schedule/Level of Effort

Indicate a project schedule (Barchart Form) of field and office activities. The level of effort shall indicate manpower and equipment, dedicated to this project and show its relation to the work schedule. This schedule will be evaluated for the ability to meet the period of performance.

Project Control Reporting

Indicate the type of project activity and cost control reporting that is proposed. Written reporting is required as detailed in paragraph 8.1.2.

Sample of Completed Lithologic Logs (Report Quality)

Provide samples of previous lithologic reports that are considered to be consistent with this Statement of Work.

Company Equipment Resources

List equipment available to perform Statement of Work. Indicate make, model, year, and hours of usage (if available).

Key Personnel

Provide resumes of key people that will be committed to this job. Indicate years of relevant experience, degrees, and expertise.

Written Drilling Sampling and Well Completion Procedures

What well/drilling procedures does the Company have or reference in performing its work? A specific plan is preferred.

Soils Laboratory

Identify who will perform soils laboratory work. In-house activities are preferred.

Detail the staffing structure for this program within organizational chart. How much of the labor resources are currently on staff?

Previous Federal Contracting Experience

Does the Subcontractor and lower tier Subs have previous Federal contracting experience?

Proposals will be evaluated according to the following schedule.

The following groups A, B, and C are in descending (group) order of importance:

A. Work Schedule/Level of Effort
Project Control Reporting
Sample of Completed Lithologic Logs (Report Quality)

B. Company Equipment Resources
Key Personnel
Written Drilling Sampling and Well Completion Procedures
Soils Laboratory

C. Management Structure and Labor Resources
Previous Federal Contracting Experience

Group D below is twice as important as Group A above:

D. Technical References
Company Prior Experience
Quality Assurance/Quality Control Plan
Health and Safety Plan

Evaluation Criteria E is most important and is four times as important as Group A above:

E. Understanding of this Task